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19XRV Familiarization, Maintenance, Troubleshooting

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October 2012

Overview

19XRV Overview

19XRV Components

Compressor Theory

Maintenance

19XRV

Chiller

- Semi Hermetic Centrifugal Chiller
- Tonnage
  - 19XR- 200 to 1,500 Nominal Tons (703 to 5275 kW)
  - 19XRV with Variable frequency Drive - 200 to 1,450 Nominal Tons (703 to 5100 kW)
- Chlorine Free HFC-134a Refrigerant
- Semi Hermetic Motor
- ASME Heat Exchangers

19XRV

Chiller Identification

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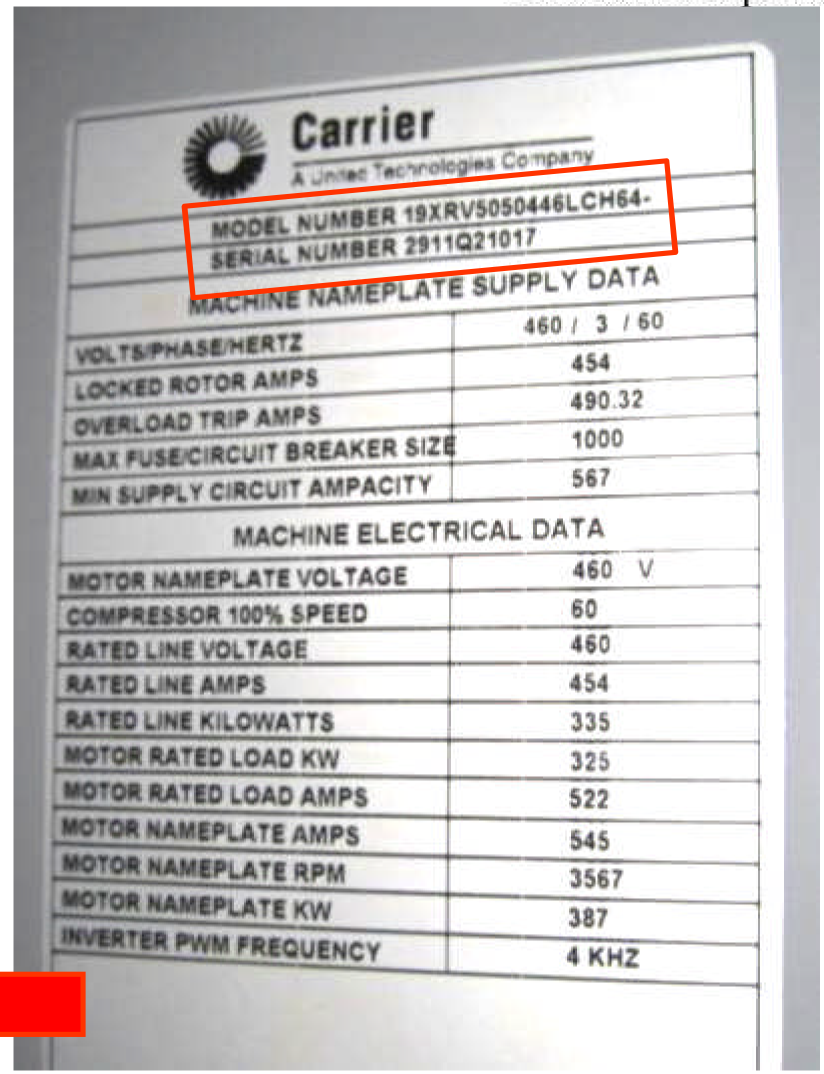

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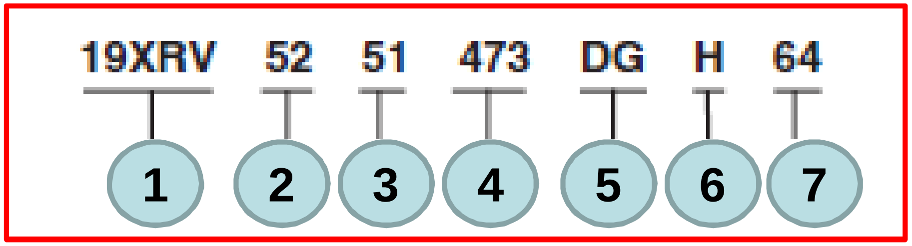
Chiller Identification



1. Chiller Type (High Efficiency Hermetic Centrifugal Chiller with Variable Frequency Drive Unit-mounted
2. Cooler Size
3. Condenser Size
4. Compressor Code
5. Motor Code
6. Motor Efficiency Code
7. Motor Voltage Code

19XRV

Chiller Identification

19XRV 52 51 473 DG H 64 –

19XRV — High Efficiency Hermetic Centrifugal Liquid Chiller with Variable Frequency Drive Unit-Mounted

Cooler Size

20-22 (Frame 2 XRV)
30-32 (Frame 3 XRV)
35-37 (Frame 3 XRV)
40-42 (Frame 4 XRV)
45-47 (Frame 4 XRV)
50-52 (Frame 5 XRV)
5A (Frame 5 XRV)
5B (Frame 5 XRV)
5C (Frame 5 XRV)
55-57 (Frame 5 XRV)
5F (Frame 5 XRV)
5G (Frame 5 XRV)
5H (Frame 5 XRV)
60-62 (Frame 6 XRV)
65-67 (Frame 6 XRV)
70-72 (Frame 7 XRV)
75-77 (Frame 7 XRV)
80-82 (Frame 8 XRV)
85-87 (Frame 8 XRV)

Condenser Size

20-22 (Frame 2 XRV)
30-32 (Frame 3 XRV)
35-37 (Frame 3 XRV)
40-42 (Frame 4 XRV)
45-47 (Frame 4 XRV)
50-52 (Frame 5 XRV)
55-57 (Frame 5 XRV)
60-62 (Frame 6 XRV)
65-67 (Frame 6 XRV)
70-72 (Frame 7 XRV)
75-77 (Frame 7 XRV)
80-82 (Frame 8 XRV)
85-87 (Frame 8 XRV)

Compressor Code
(First Digit Indicates Compressor Frame Size)*

Special Order Indicator
– — Standard
S — Special Order

Motor Voltage Code

Code	Volts-Phase-Hertz
62	380-3-60
63	416-3-60
64	460-3-60
52	400-3-50

Motor Efficiency Code
H — High Efficiency
S — Standard Efficiency

Motor Code

Compressor Frame

2	3	3	4	4	5
BD	CD	KB	DB	LB	EH
BE	CE	KC	DC	LC	EJ
BF	CL	KD	DD	LD	EK
BG	CM	KE	DE	LE	EL
BH	CN	KF	DF	LF	EM
BJ	CP	KG	DG	LG	EN
	CQ	KH	DH	LH	EP
	CR		DJ		EQ
			DK		

*Second digit will be a letter (example 4G3) on units equipped with split ring diffuser.

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Compressor Code

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19XRV 52 51 473 DG H 64

4 **7** **3**

- 3: Wheel diameter – Lift
- 7:
  - Wheel Shroud Size – Capacity
  - Alphabet – Unit with split ring diffuser
- 4:
  - Compressor Frame Size 2,3,4,5
  - Frame 2 – Up to 350 tons
  - Frame 3 – Up to 550 tons
  - Frame 4 – Up to 900 tons
  - Frame 5 – Up to 1600 tons

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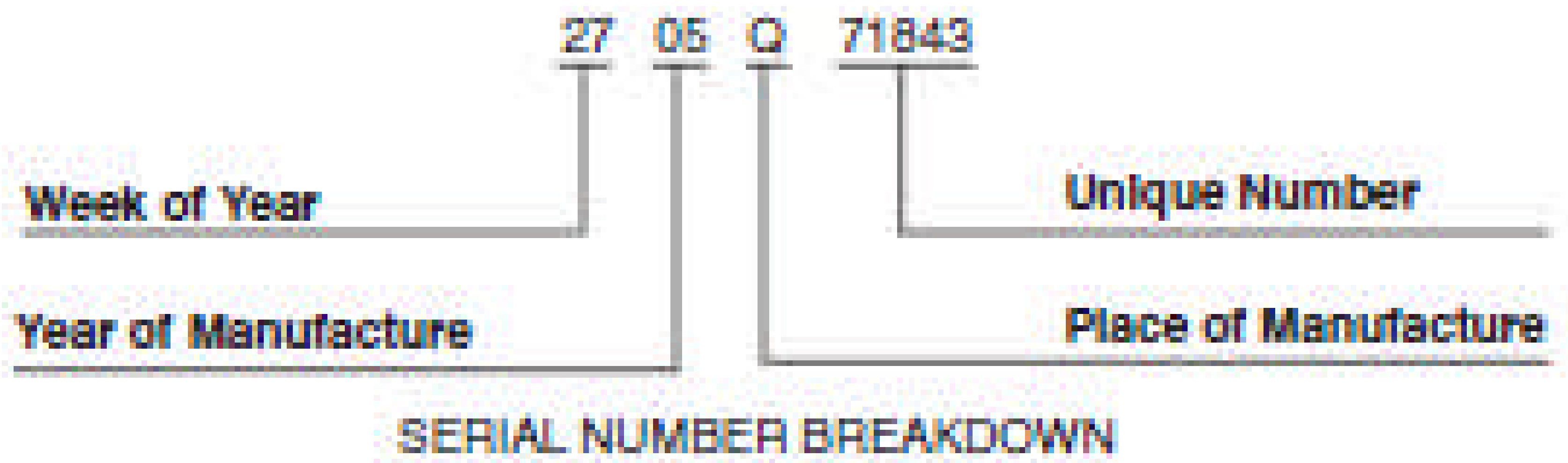
Chiller build date and serial



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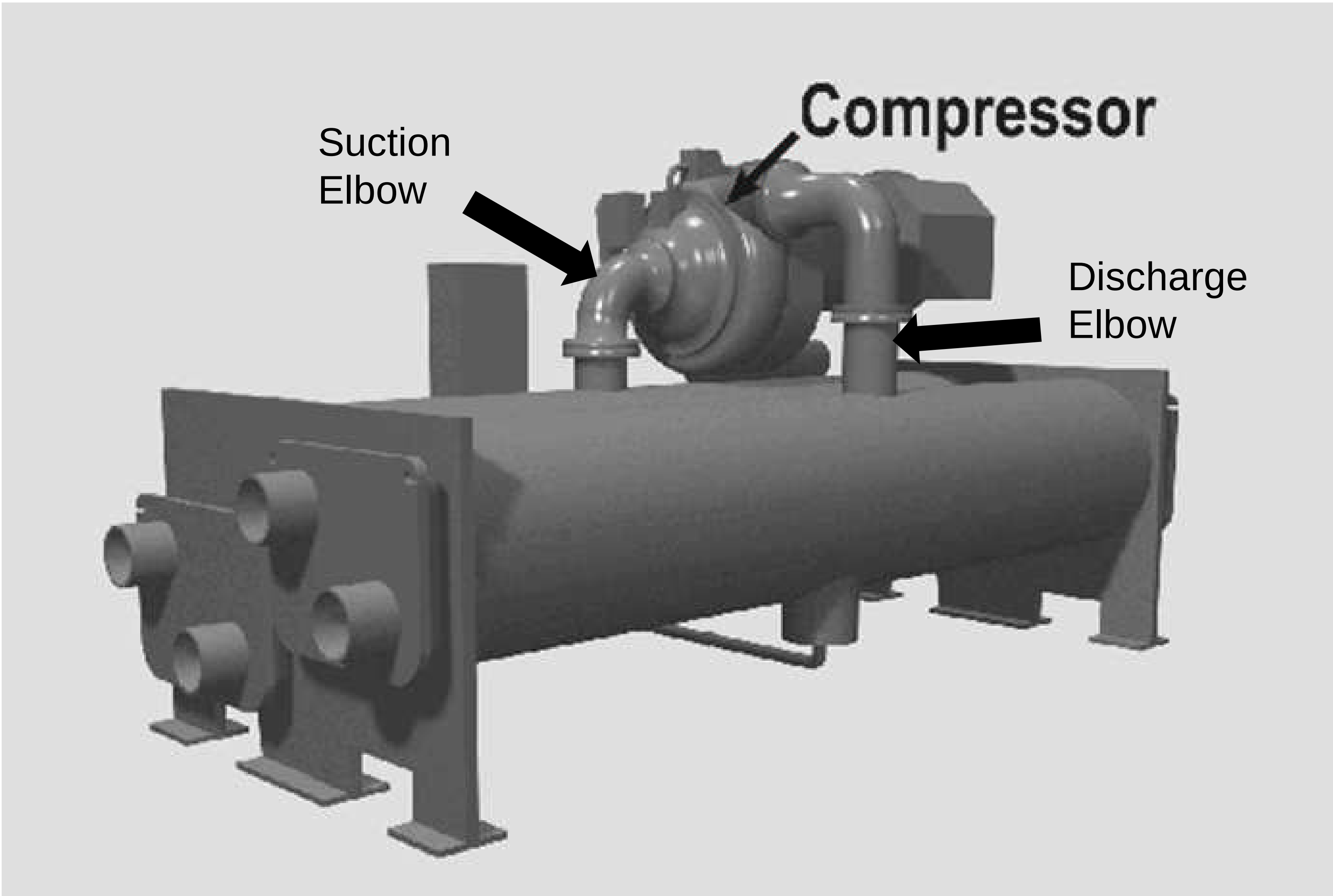
Chiller



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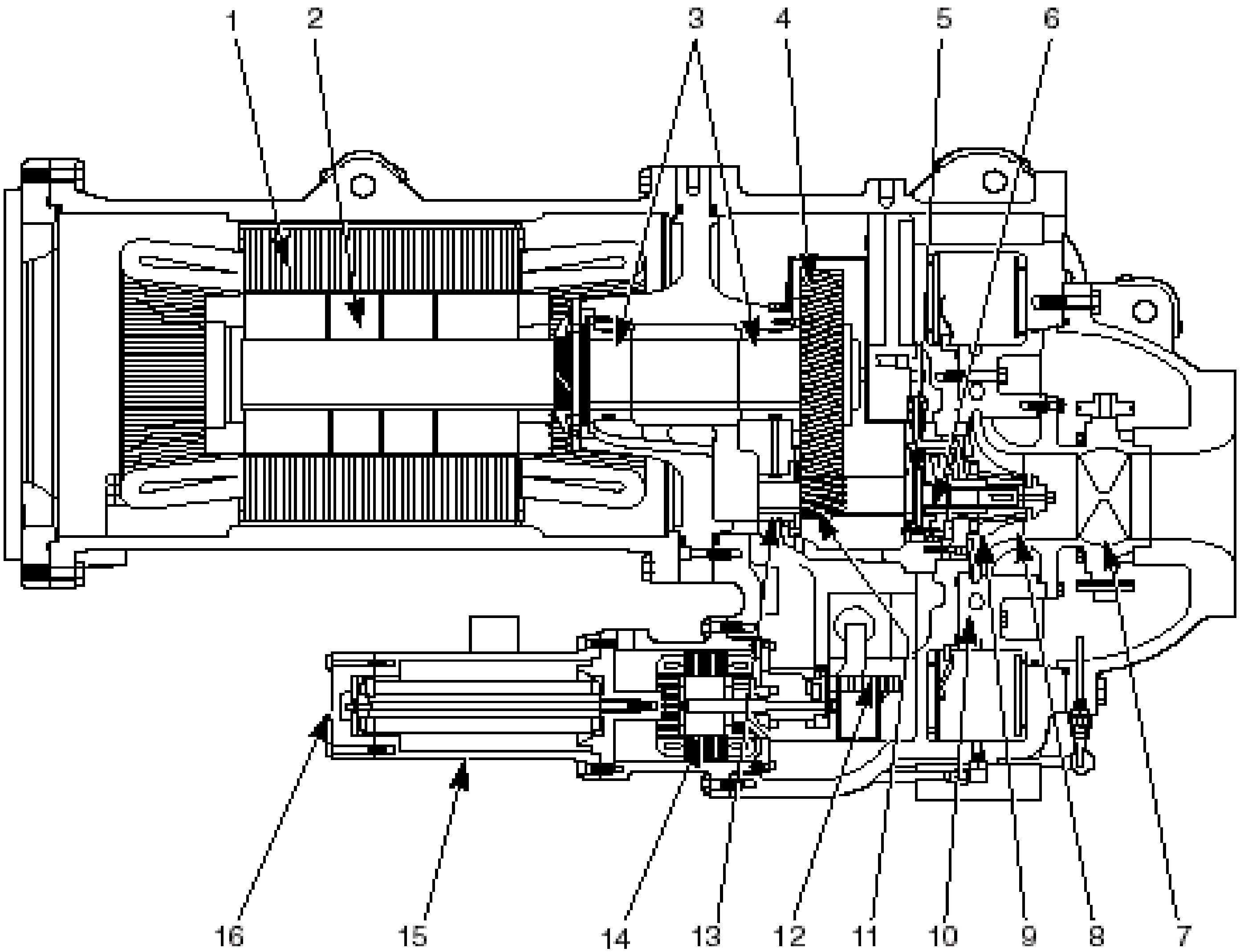
Chiller

COMPRESSOR COMPONENTS



1. Motor Stator
2. Motor Rotor
3. Motor Shaft journal bearings
4. Low Speed bull gear
5. High speed shaft thrust bearing
6. High speed shaft bearing
7. IGV
8. Impeller shroud
9. Impeller
10. Pipe Diffuser
11. High Speed pinion gear
12. Oil heater
13. High Speed shaft bearing
14. Oil pump motor
15. Oil Filter
16. Oil Filter Cover

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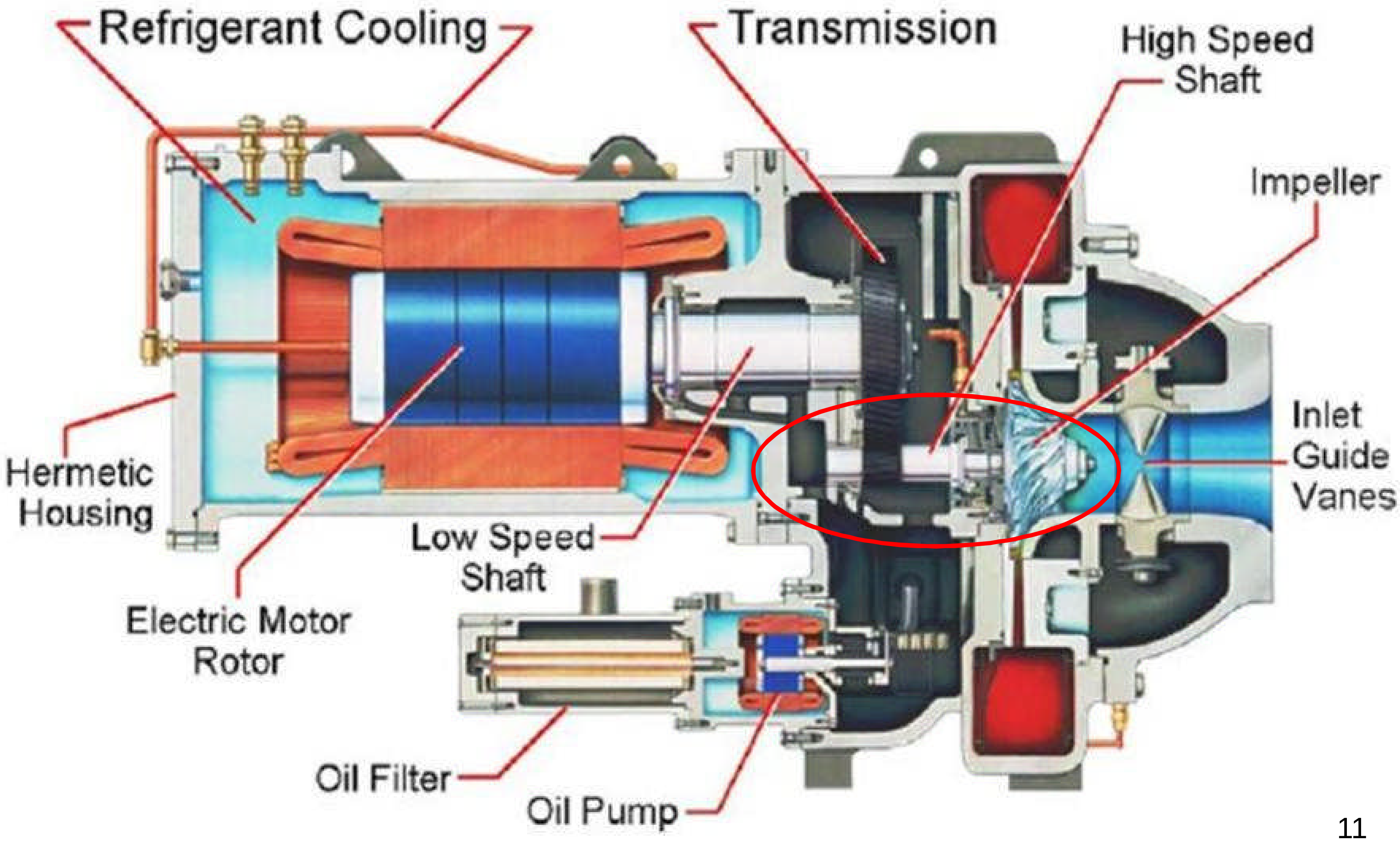
Compressor Section View



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Chiller

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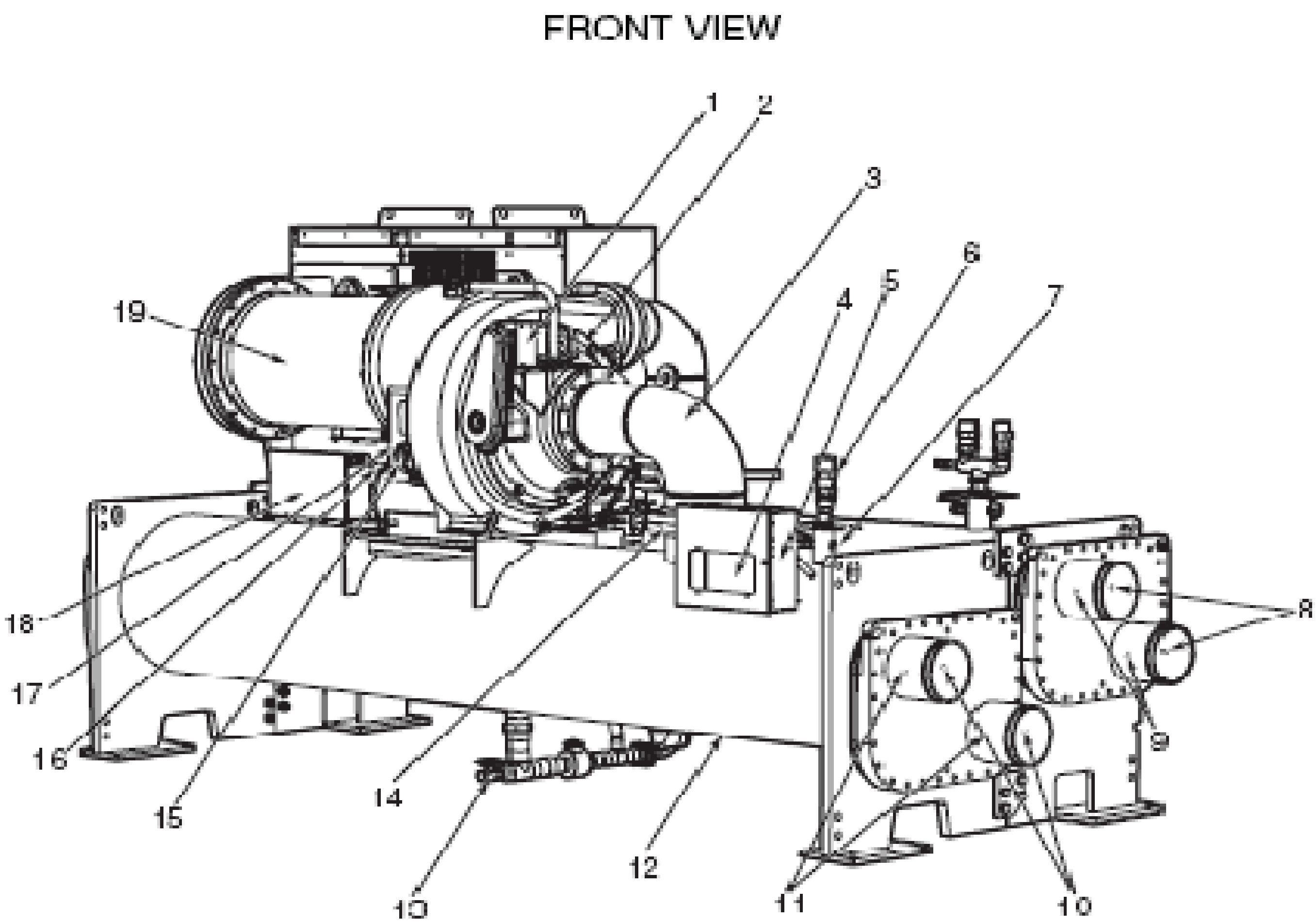

1. Guide vane Actuator
2. SRD Actuator
3. Suction Elbow
4. ICVC
5. Chiller ID Plate
6. Cooler Relief valves
7. Cooler Press Transducer
8. Cond I/O Temp
9. Cond flow device (optional)
10. Cooler Flow device (optional)
11. Cooler I/O Temp
12. Evap Saturation Temp
13. Liquid Line Service Valve
14. Flange connection
15. Oil level SG
16. Oil Cooler
17. Oil drain/charging valve
18. Power Panel
19. Motor housing

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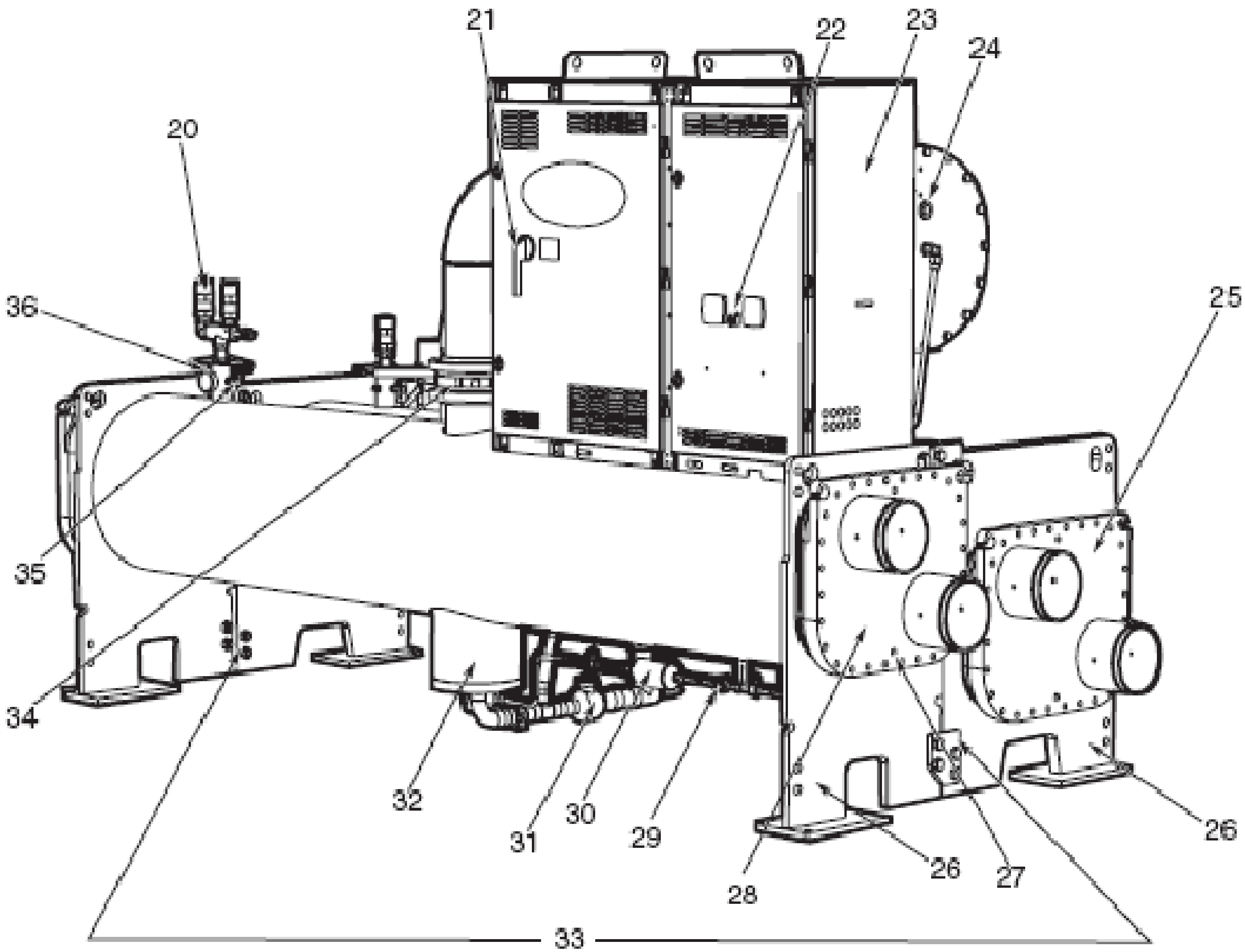
Chiller



20. Condenser relief
21. VF circuit Breaker
22. VFD Meter Package
23. VFD
24. Motor Sight glass
25. Cooler waterbox Cover
26. ASME Nameplate
27. Waterbox drain
28. Condenser waterbox cover
29. Moisture/Flow indicator
30. Refrigerant filter/drier
31. Liquid line isolation (optional)
32. Linear Float valve chamber
33. Tubesheet mounting brackets
34. Discharge Isolation (optional)
35. Refrigerant charging valve
36. Condenser pressure transducer

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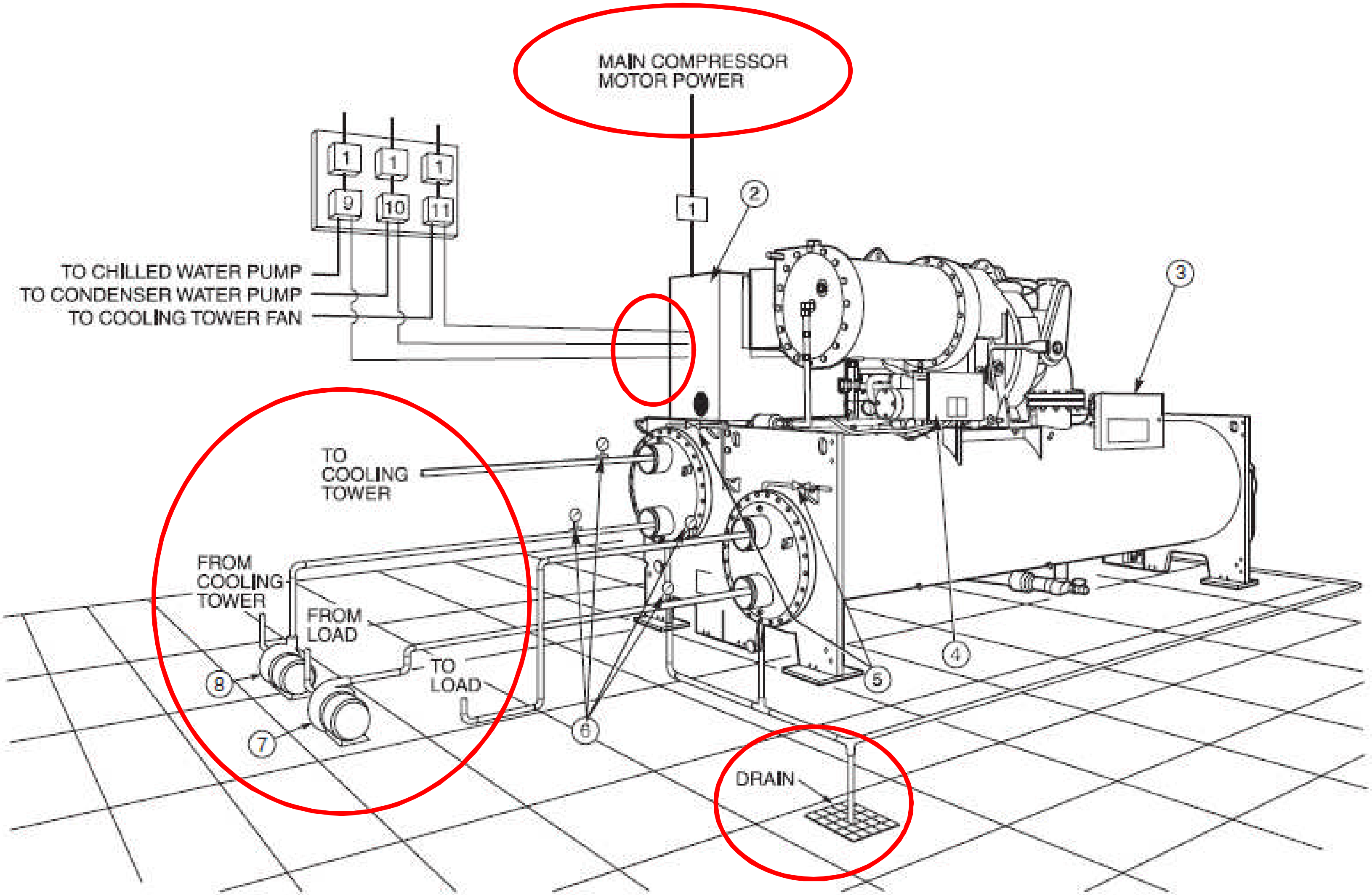
Field Connections



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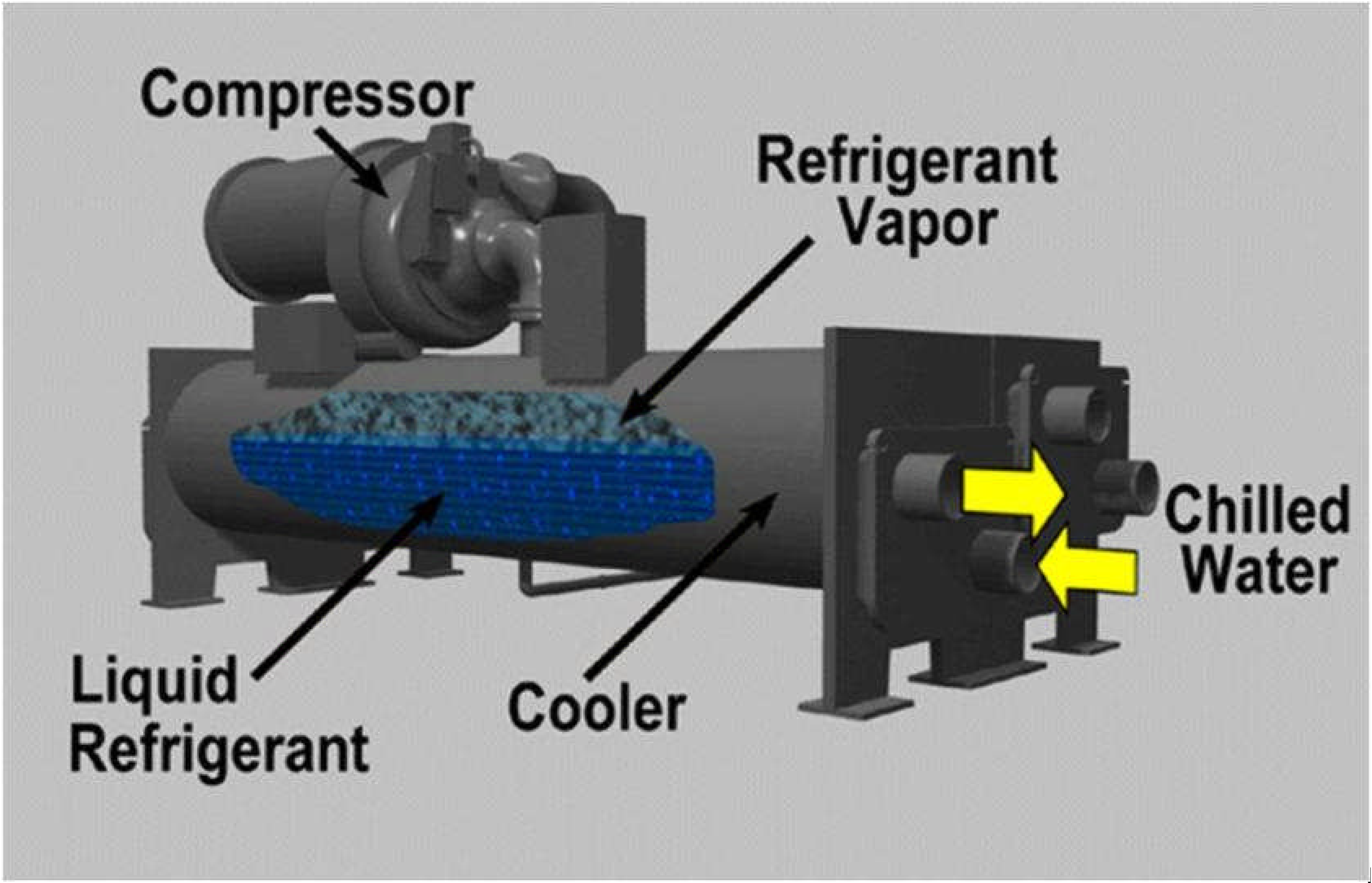
Chiller



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Chiller

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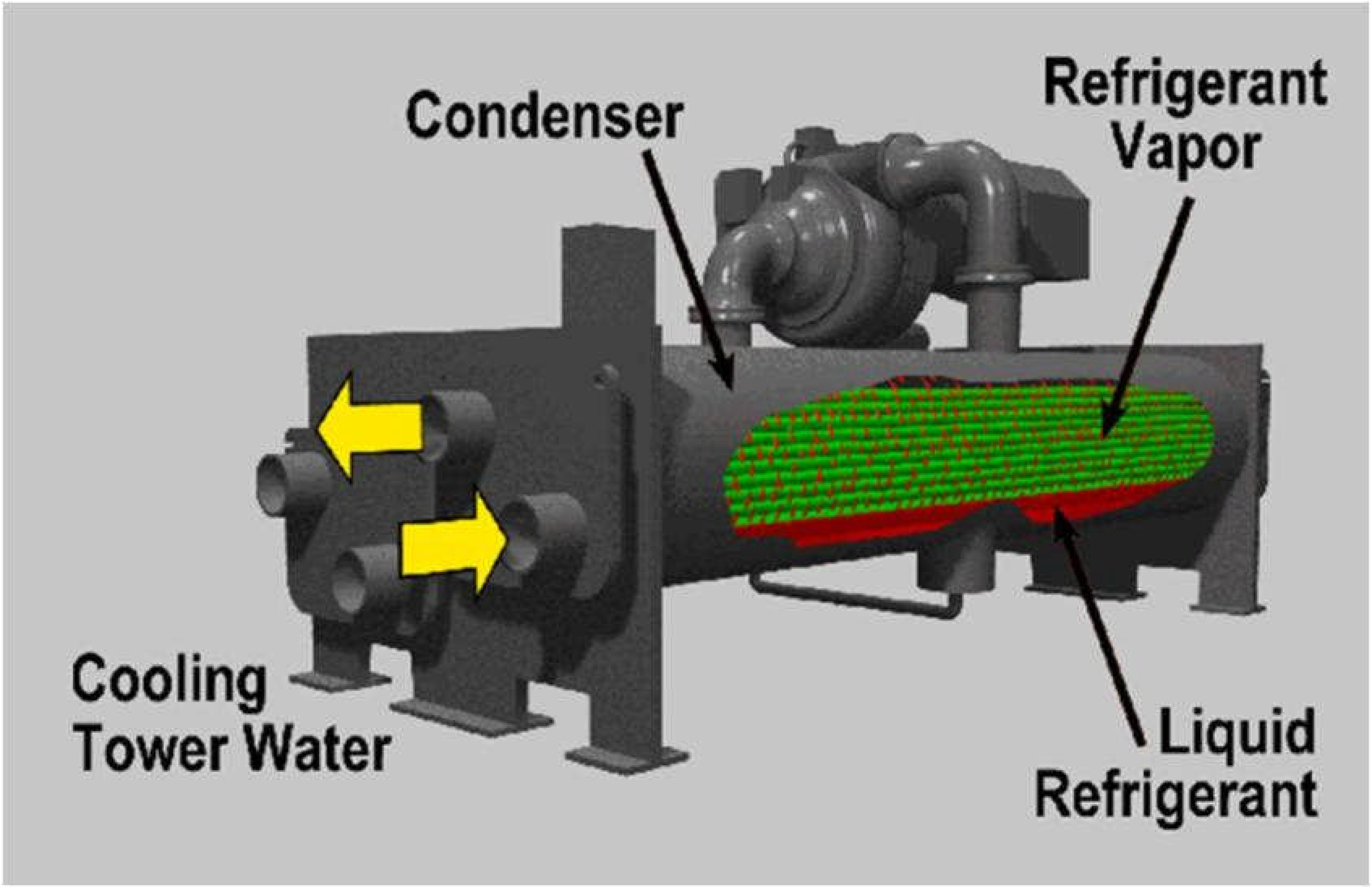

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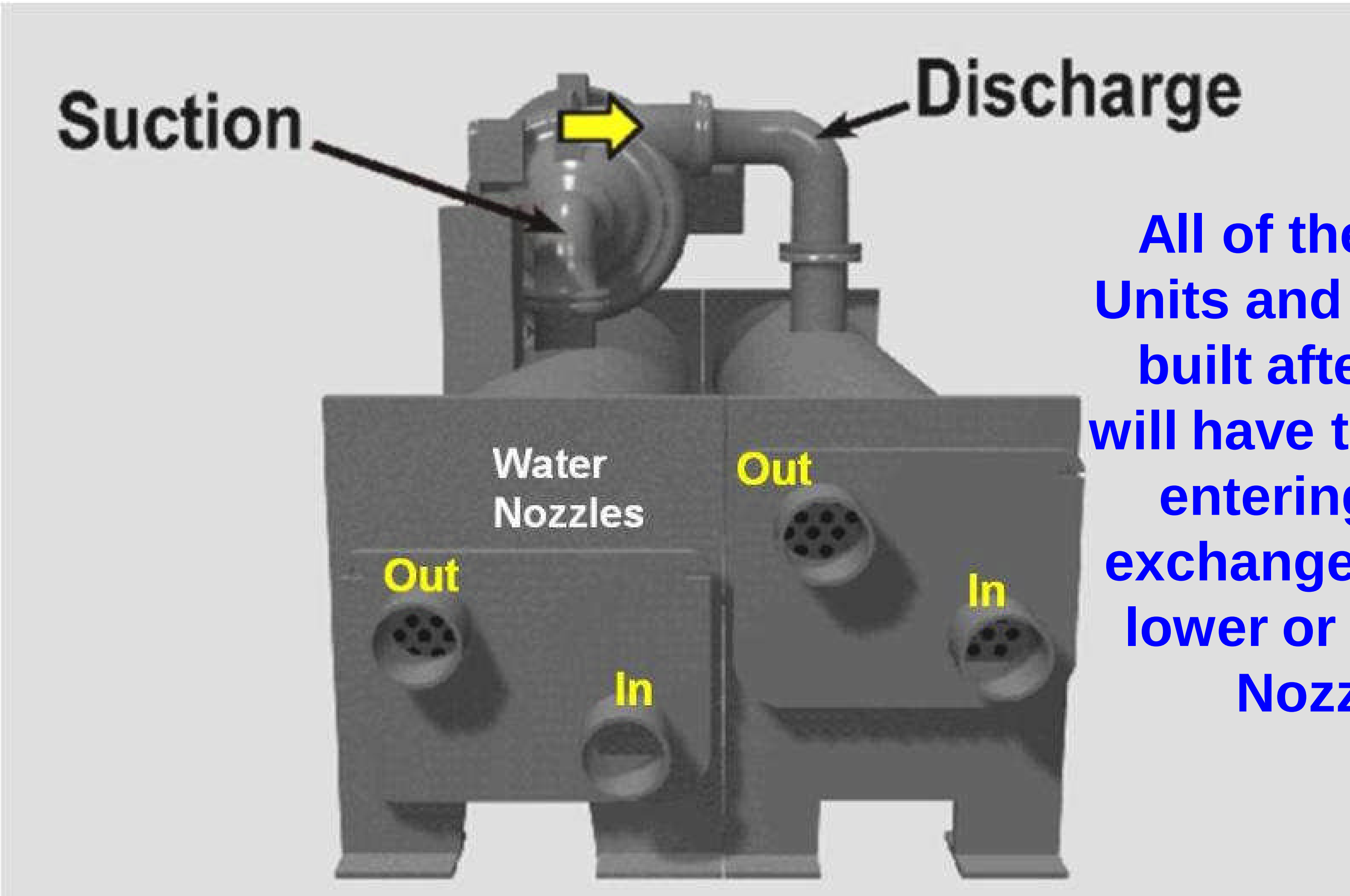
Chiller



All of the 19XR Units and any unit built after 1992 will have the water entering heat exchanger on the lower or bottom Nozzle.

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Chiller

The vessels are a shell and tube design with a relief valve setting of approximately 185psi or 115ºF

19XRV

Chiller

Condenser Components are:

Impingement Baffle
Flasc Chamber
Flasc Orifices(2)
Linear Float
Tubes with support sheets

Cooler Components are:

Distribution chamber
Tubes with support sheets

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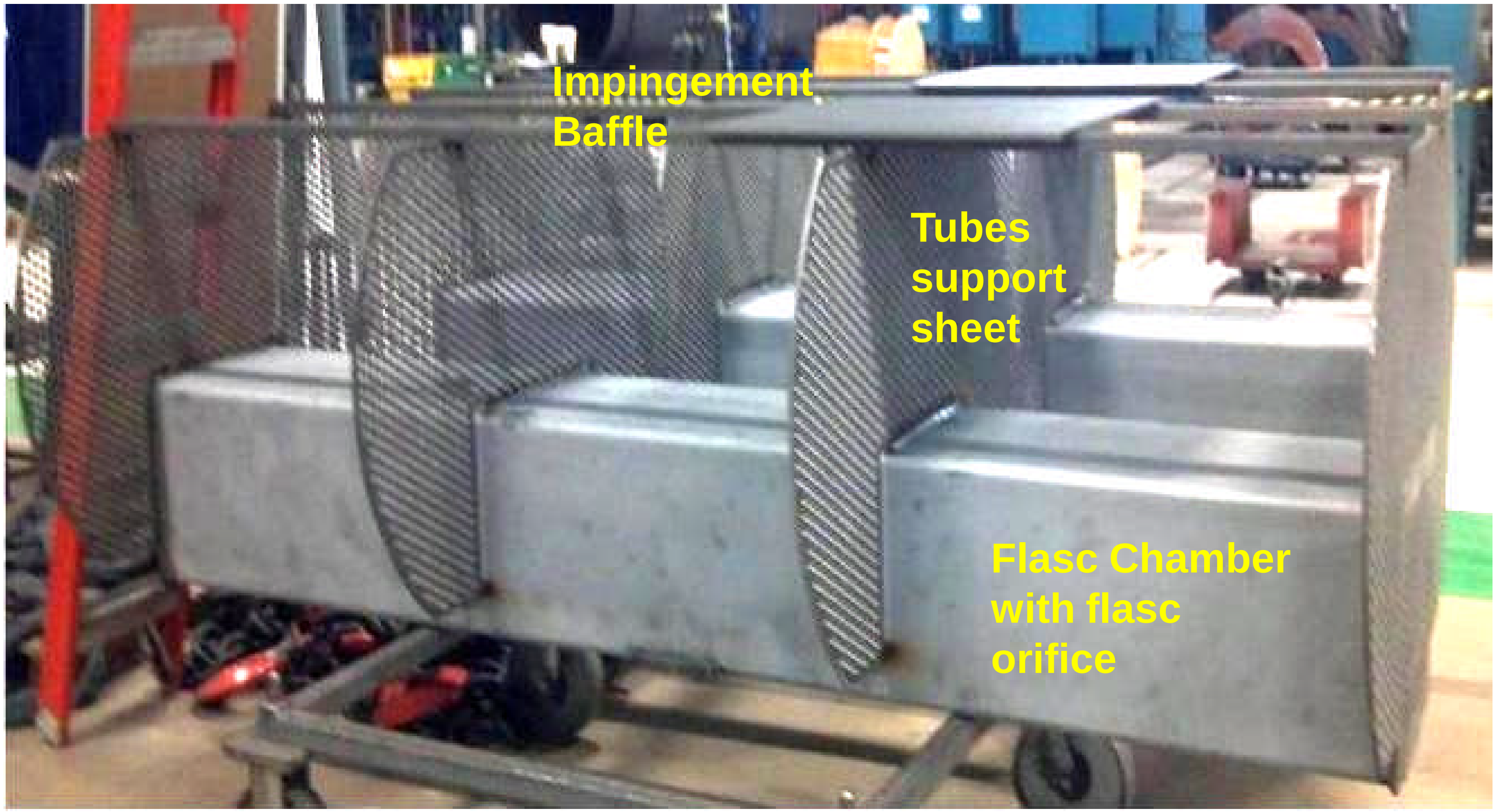
Condenser Flasc Chamber & Tube Sheet



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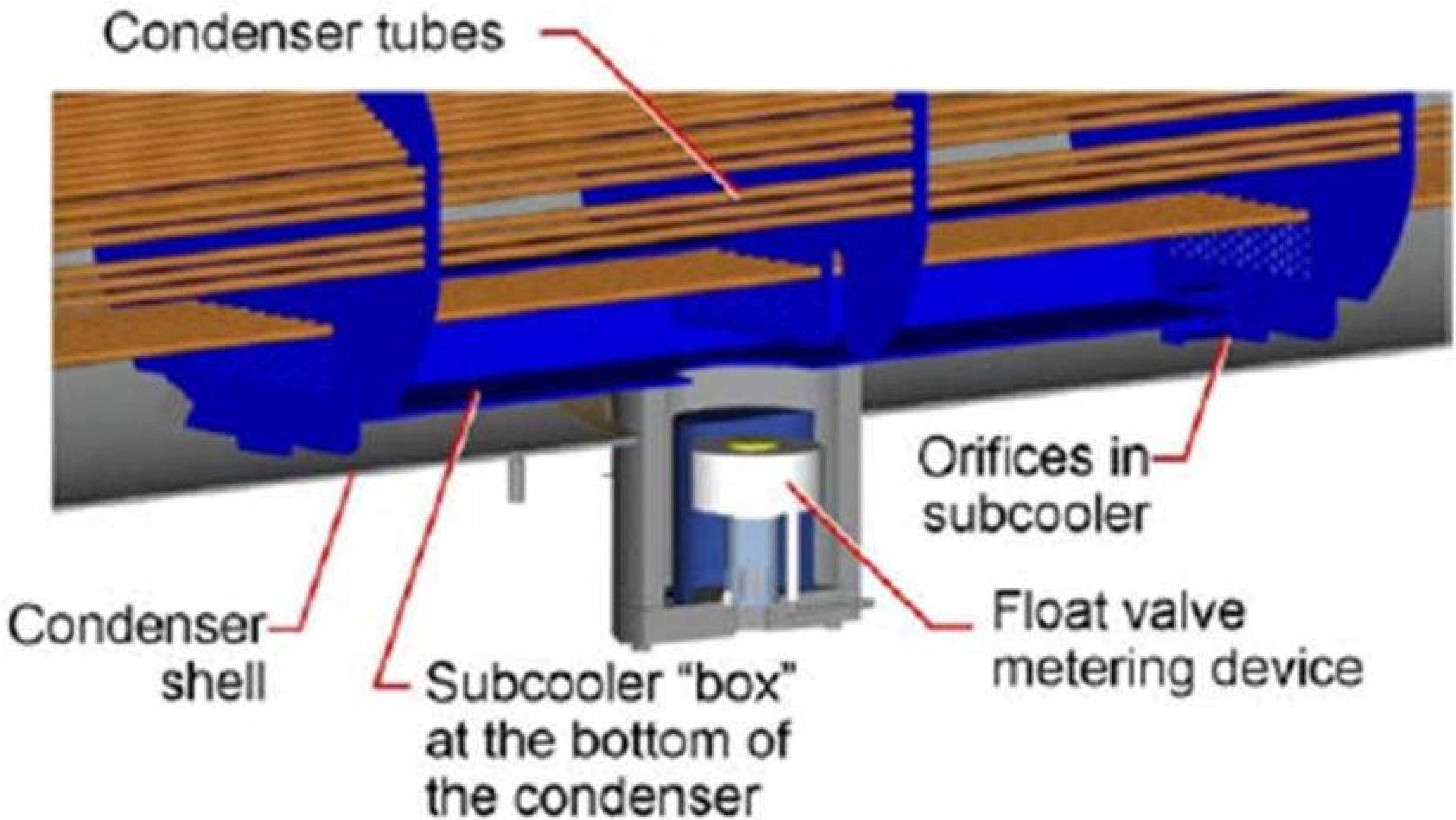
Condenser Subcooler



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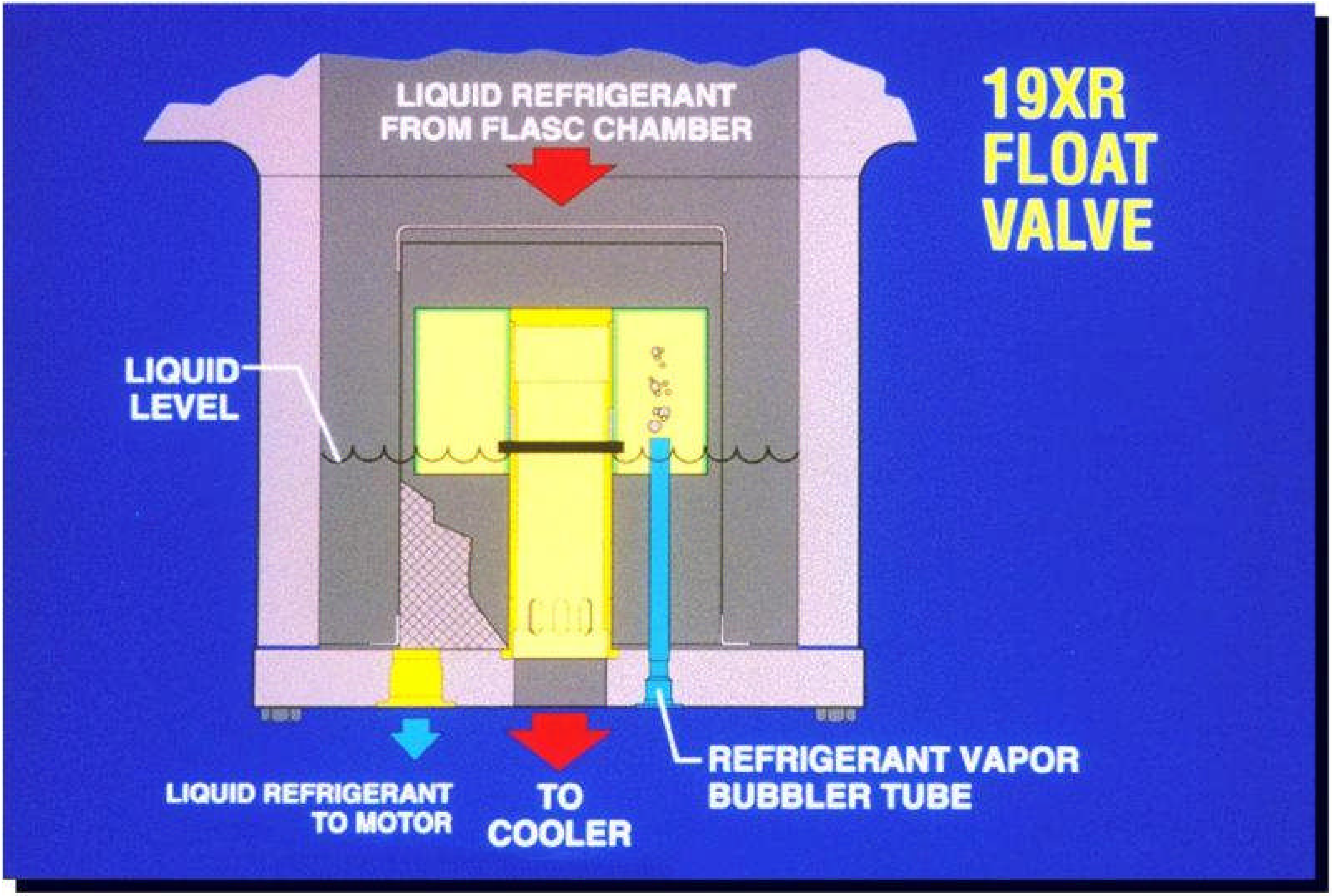
Float Valve



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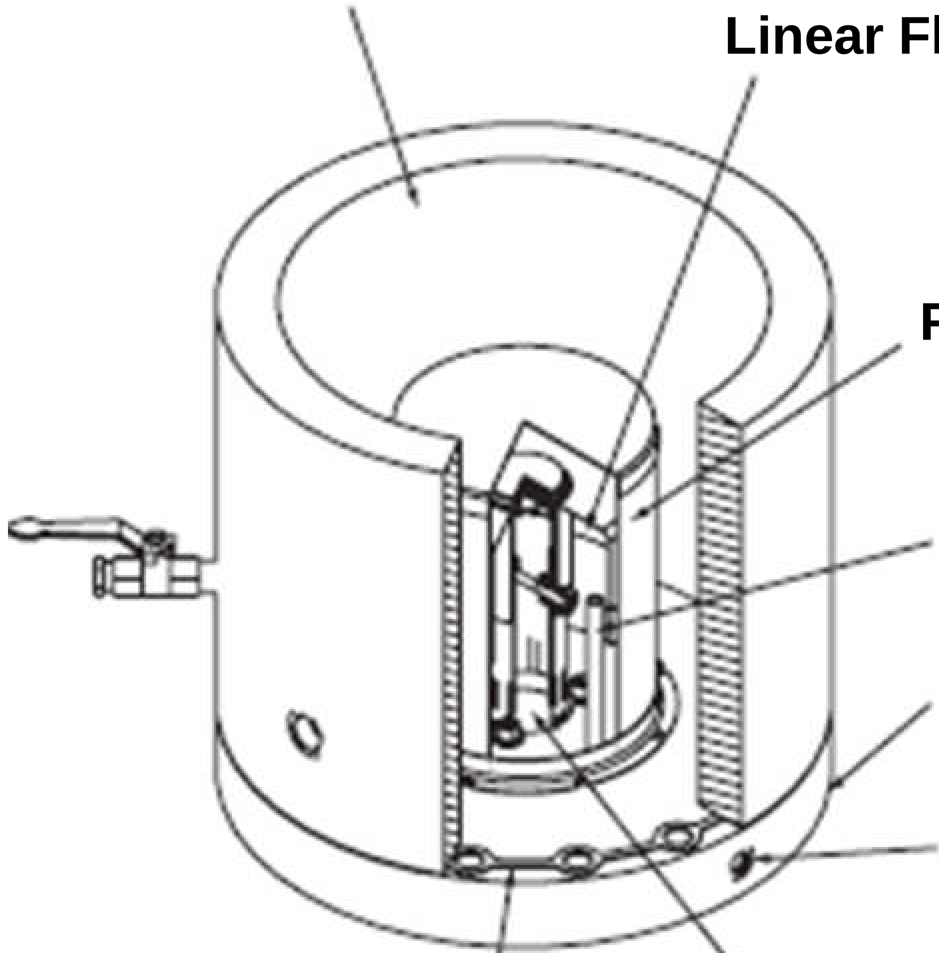
Float Valve



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Float Valve

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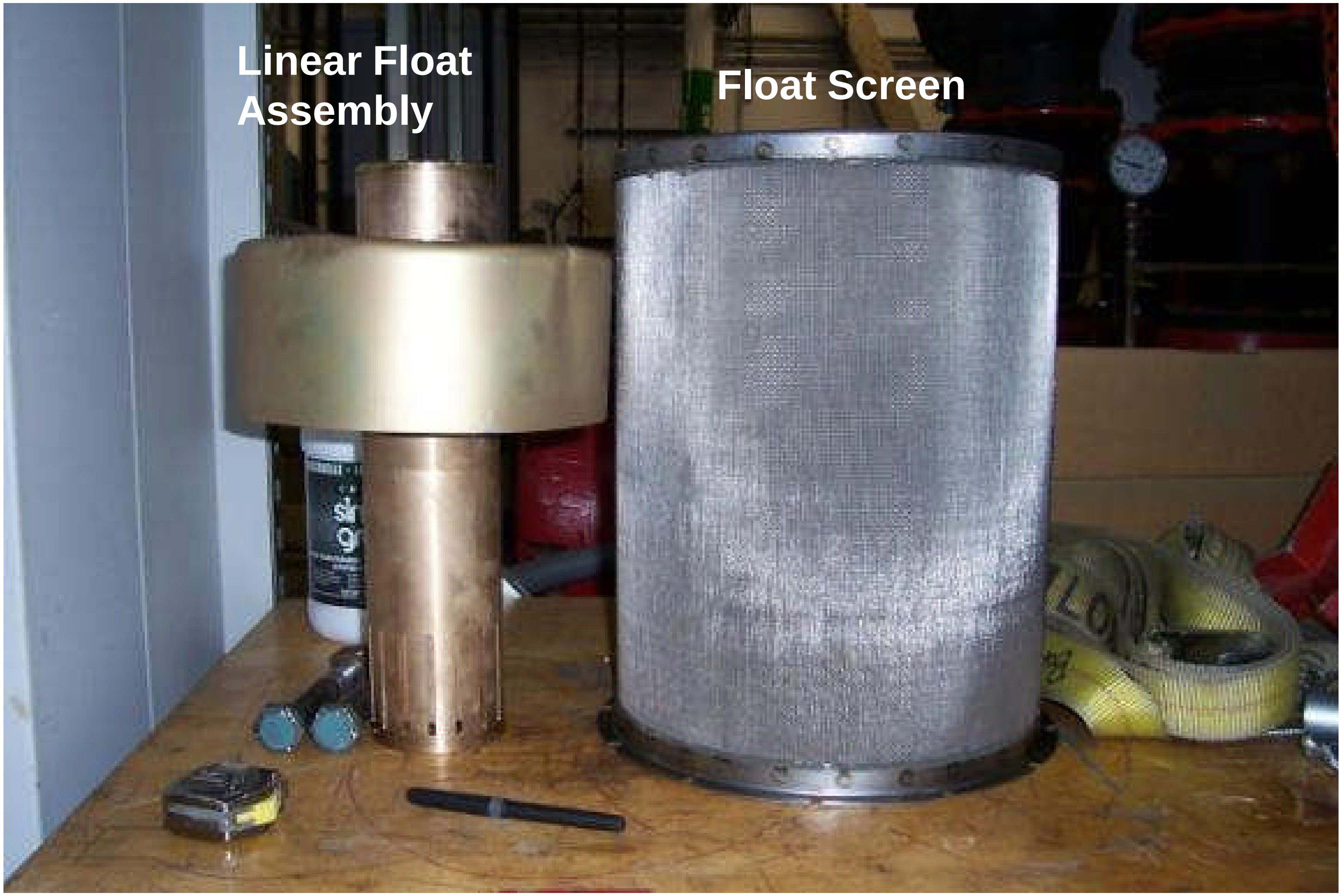

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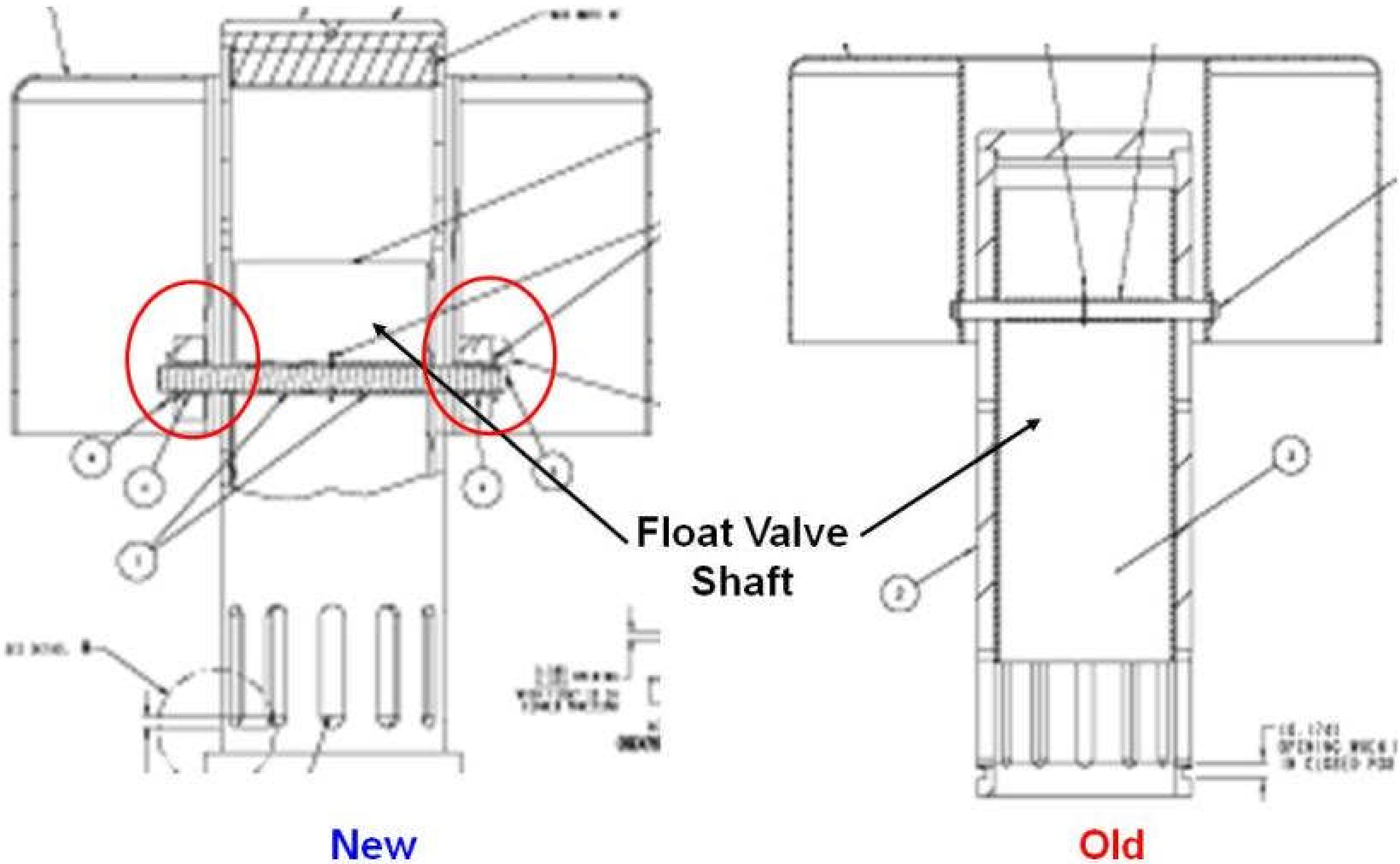
Float Valve



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Float Valve

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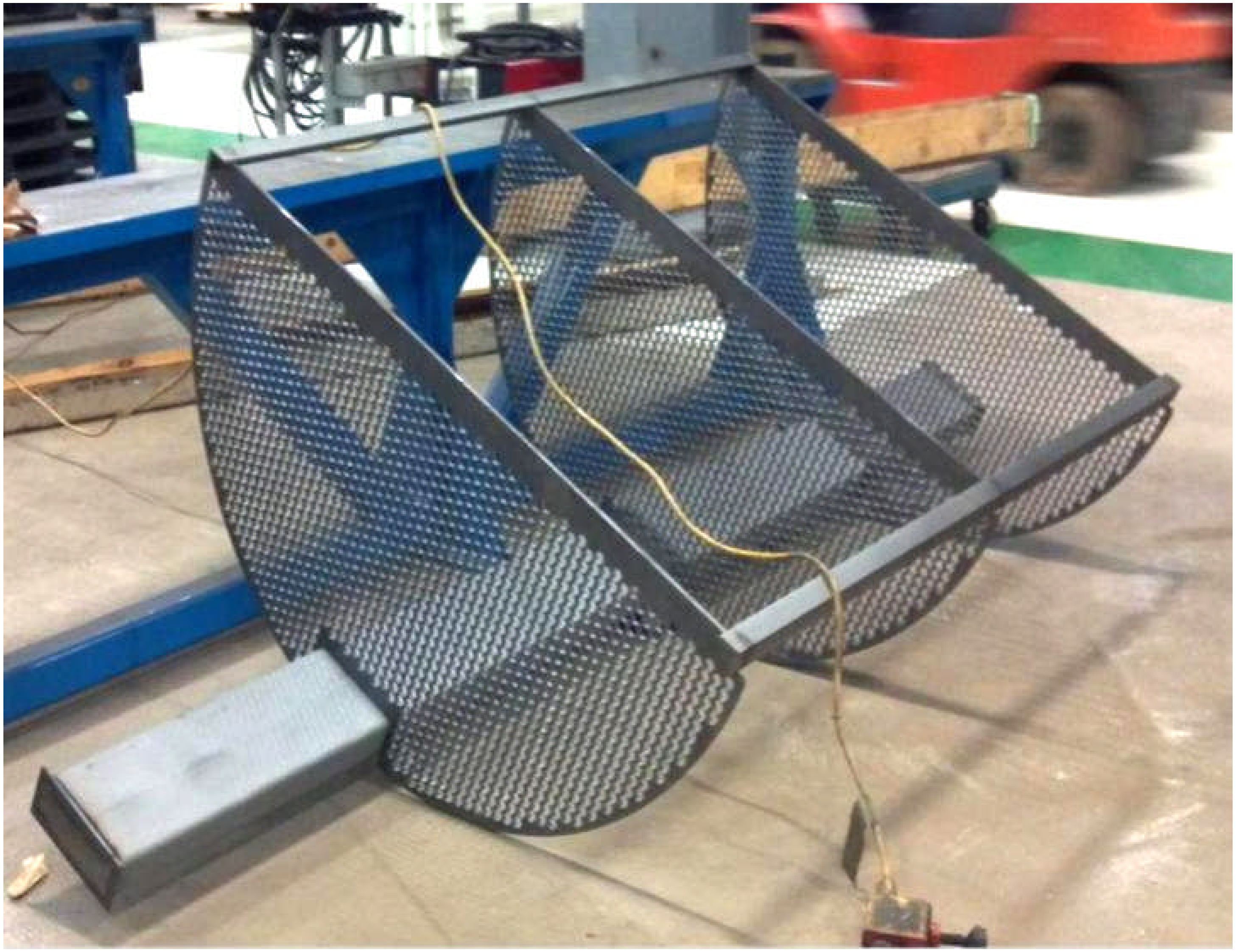
Evaporator distribution chamber & support sheet



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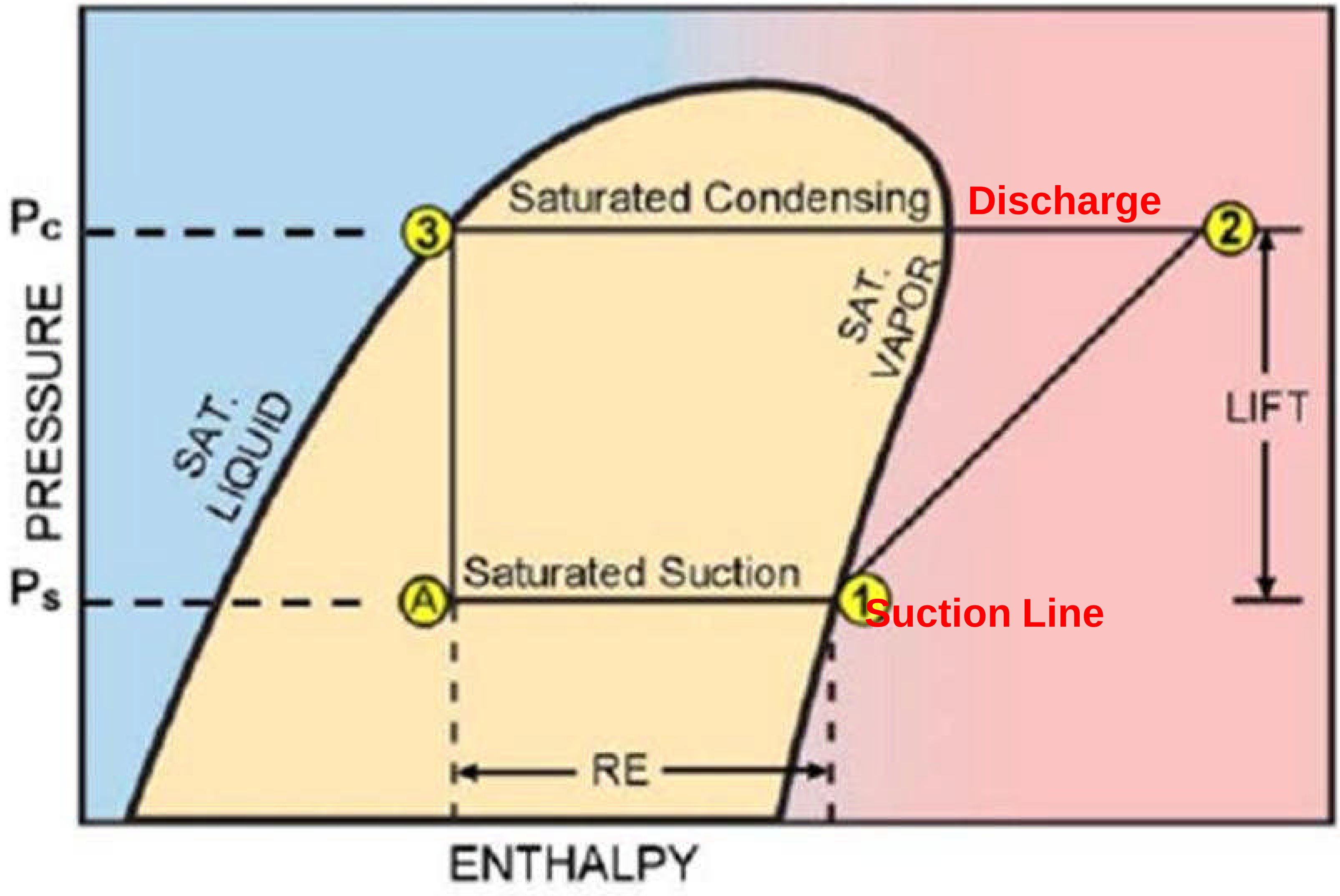
Chiller



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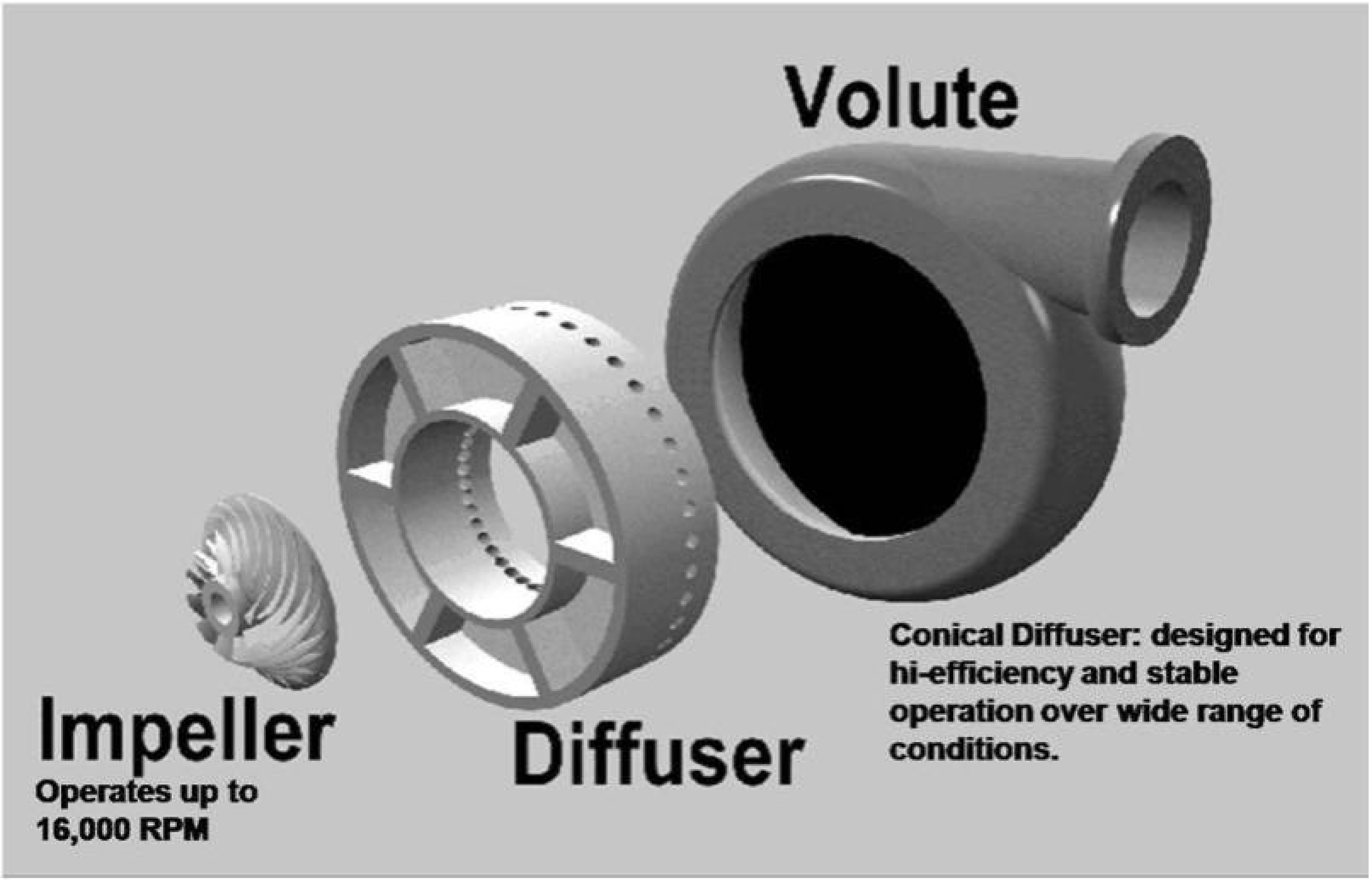
Compressor Theory



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Compressor Theory

1. Impeller
   - Low pressure refrigerant enters the comp through the eye of impeller
   - The blade of impeller form flow passages for refrigerant
   - Impeller rotates at high speed and as the gas flow towards the tip, momentum increase and that increases the static pressure

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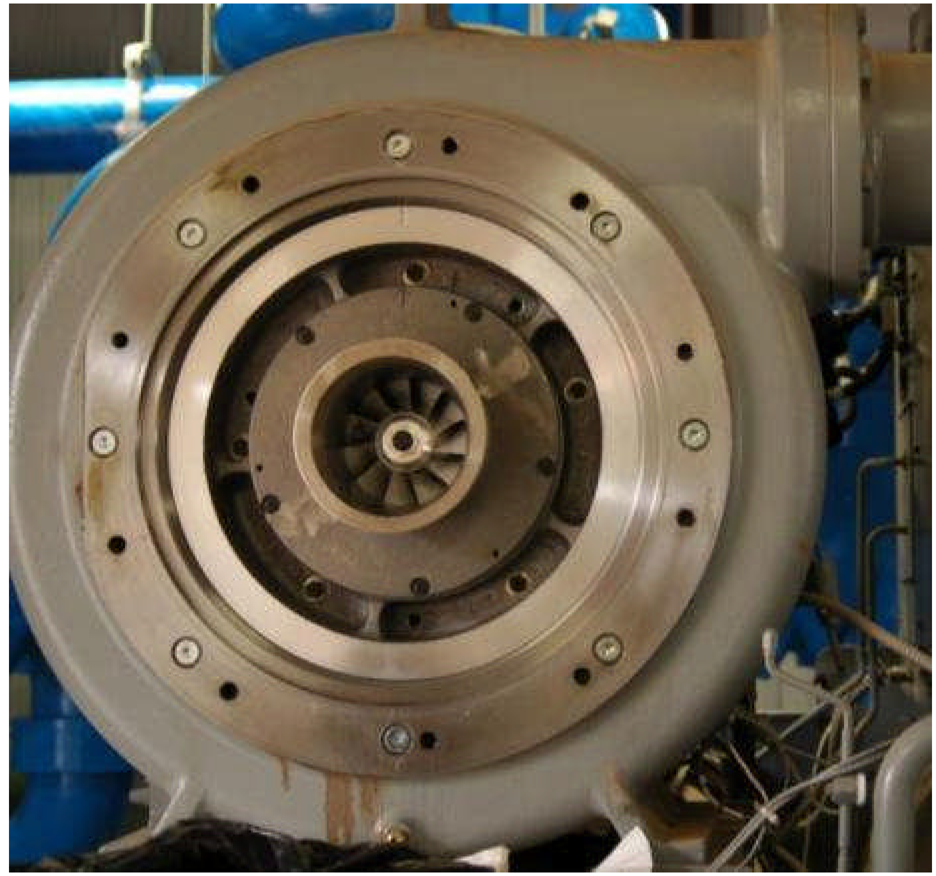
Compressor Theory

1. Diffuser
   - From the tip of impeller, refrigerant flow into diffuser.
   - Refrigerant is decelerated.
   - The dynamic pressure drop, converted to static pressure rise, causing static pressure to increase further
2. Volute
   - Vapor from diffuser enters volute, the shape of volute creates more velocity white it directs pressurized refrigerant out of compressor



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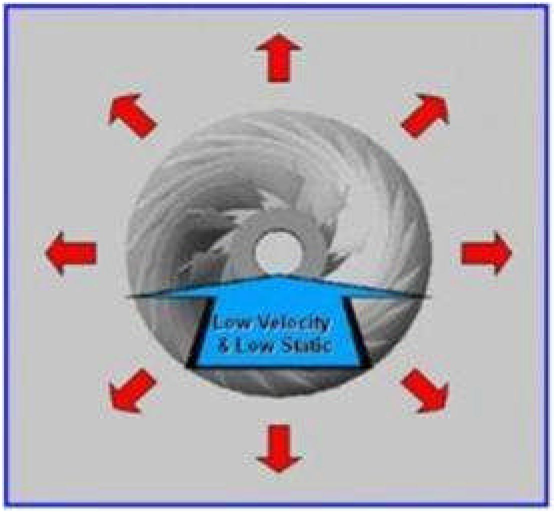
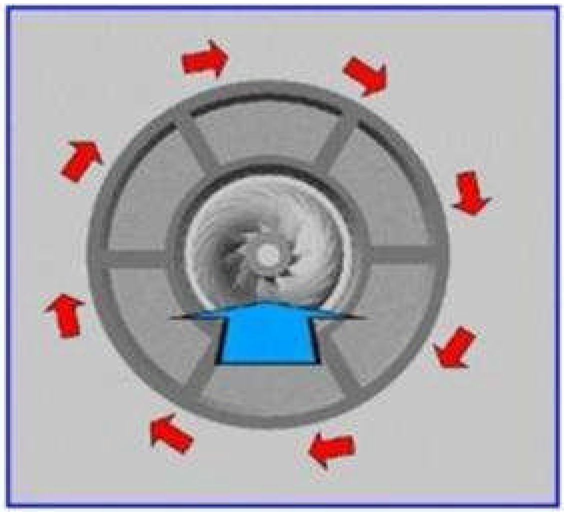
Compressor Theory



The refrigerant follows Bernoulli's Basic "Law of conservation of Energy"

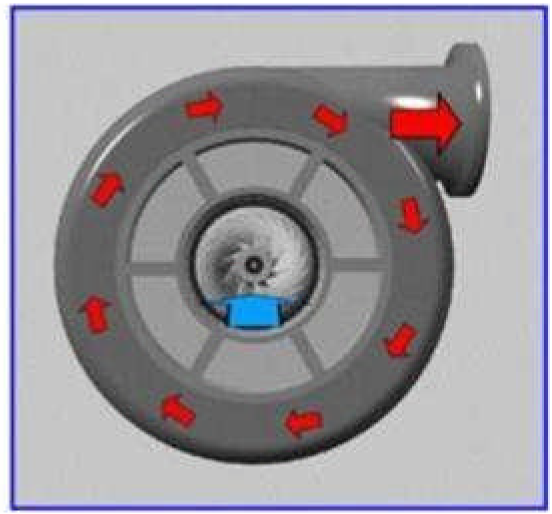
Leaves the Impeller Tips @ High velocity, Low static

Accelerate Refrigerant Vapor



Diffuser pipes slow down the vapor to convert to high static, low velocity.

Changes flow direction



The Volute collects the vapor and conveys it to the discharge connection.

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Compressor Theory

Step 1- Refrigerant is drawn into the impeller and accelerates the gas imparting “Kinetic Energy or the energy of motion”

Step 2- The accelerated refrigerant discharges from the compressor flowing through the diffuser passage. The passages increase in size, allowing the gas to expand, reducing the velocity. The kinetic energy is converted to static pressure.

The radial and tangential forces combine to generate the energy to convert the kinetic energy to static pressure

The radial force is directly proportional to the volume or CFM of the refrigerant handled

The tangential velocity is directly proportional to the impeller rotational speed times the impeller diameter

Inlet Guide Vane

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What is the purpose of Inlet Guide Vane ?

The inlet guide vanes control the unit capacity by metering the refrigerant vapor flow through the compressor.

The guide vanes are closed at start up reducing the inrush current of the motor at start up.

The inlet guide vanes are limited by motor current and Leaving Fluid temperature.

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Compressor Theory – Guide Vane Actuator

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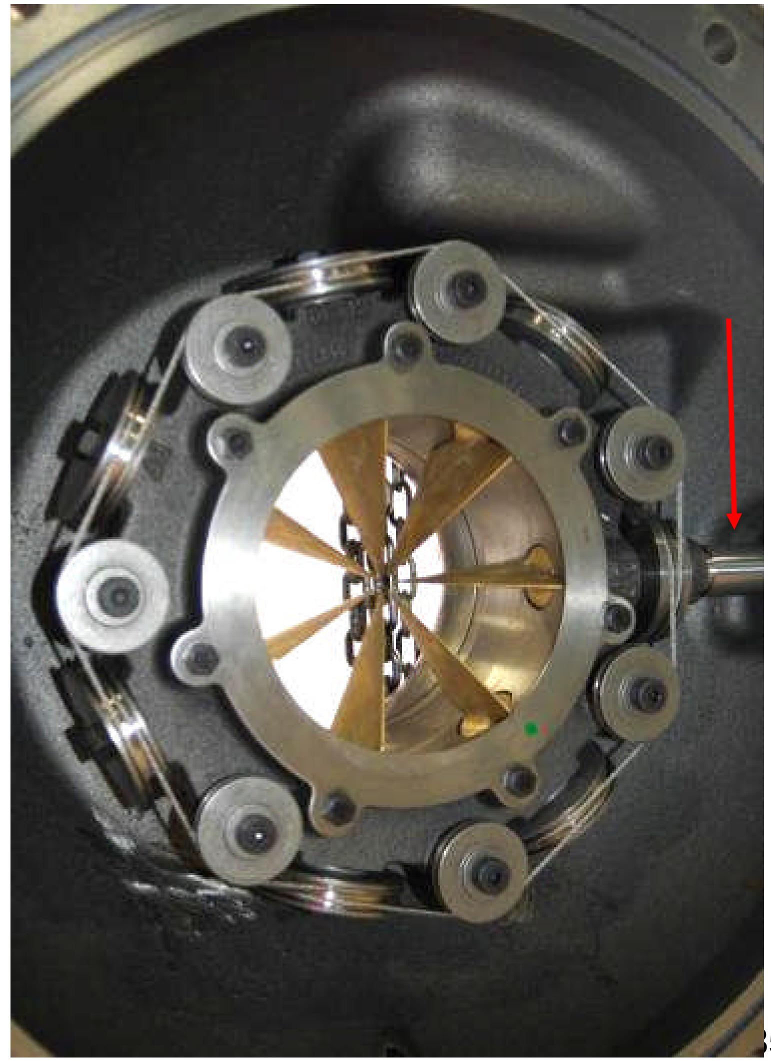

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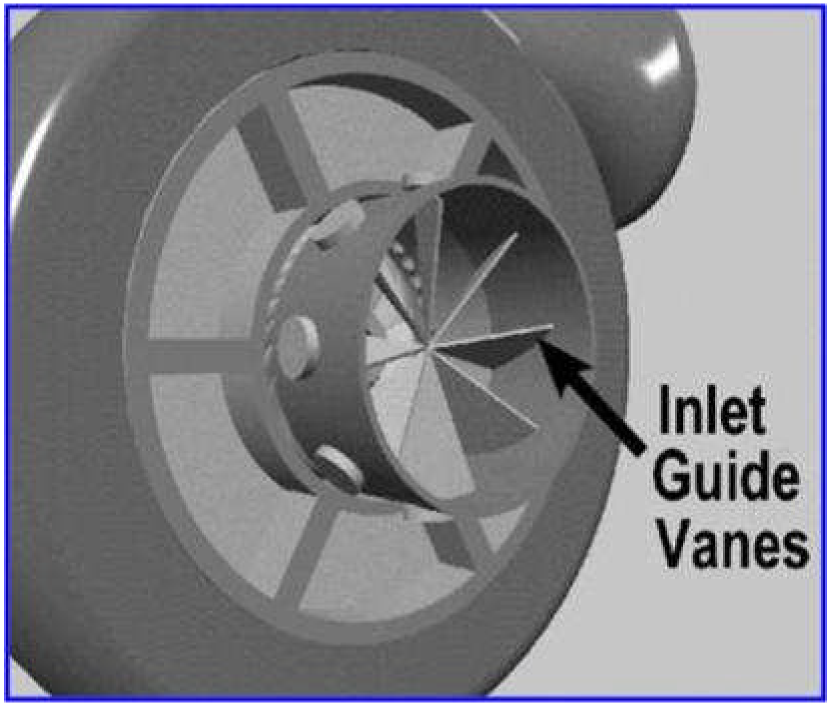
Inlet Guide Vanes



- Added at the inlet eye of impeller, called “inlet guide vane”, for capacity control
- Provide inlet pressure drop
- Impact wheel motion to gas, which reduces work for impeller
- Increase part load stability
- Closed at startup to reduce inrush current of motor at startup

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Inlet Guide Vanes

- 0~10% -- IGV acts as a valve/Throttling device
- Above 10% -- IGV changes direction of impact of gas on impeller
- Suction gas that passes the guide vanes is rotated
  - Rotation against direction of impeller produce greatest lift
  - Rotation with direction of impeller reduce lift
- Lift is what controls cooler temperature
- IGV opening is limited by motor current and leaving fluid temperature

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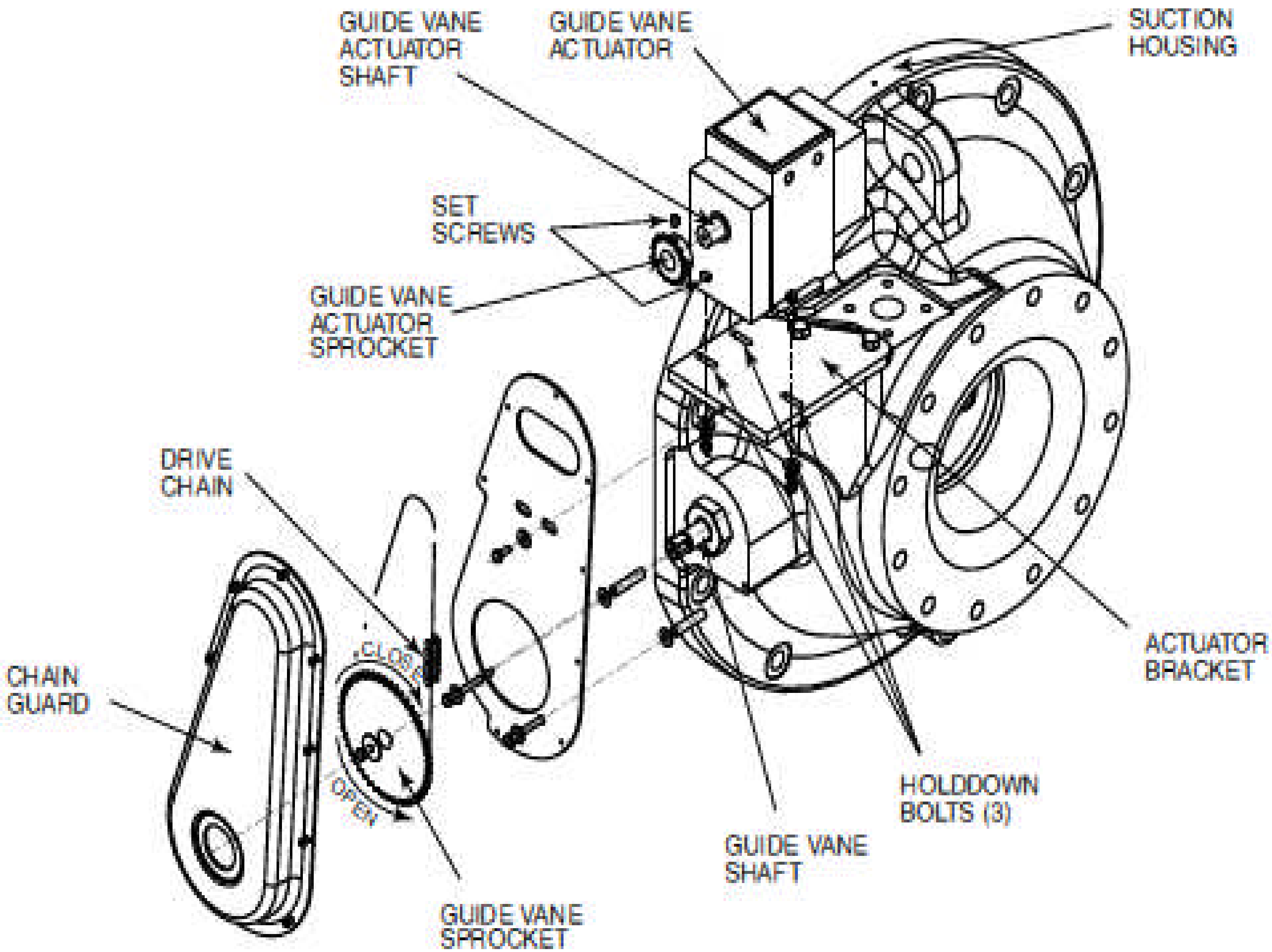
Inlet Guide Vane Assembly



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Compressor Theory

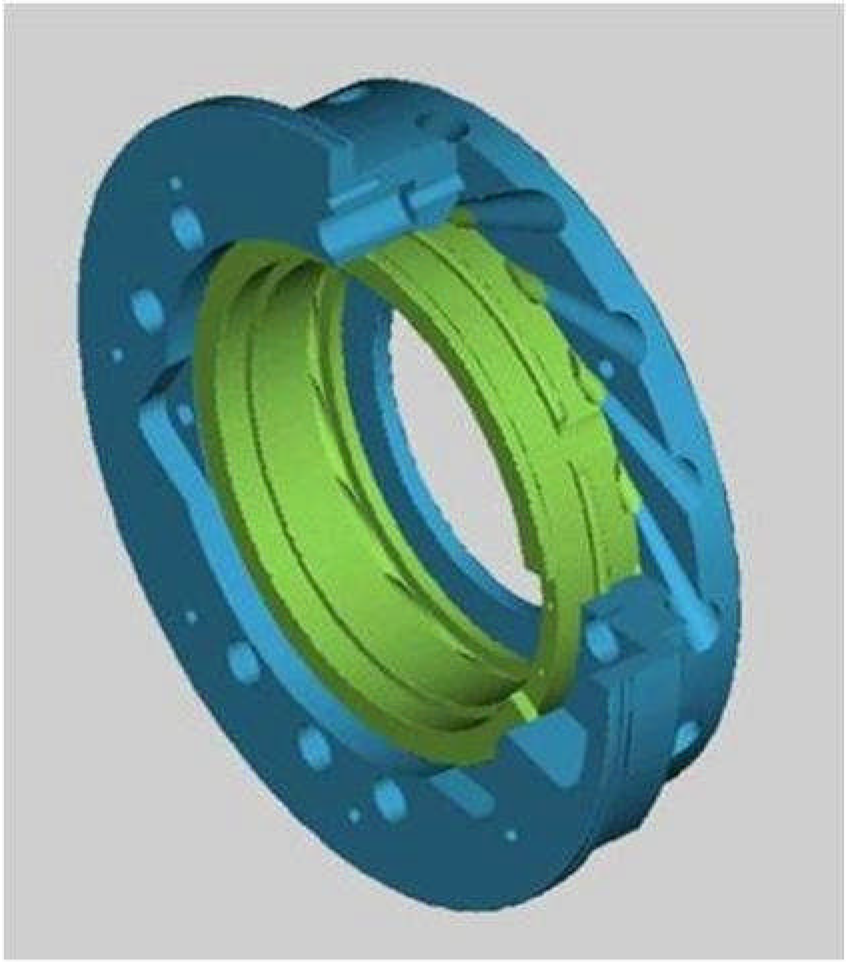
Split ring Diffuser

19XR Frame 4/5 Compressors

Closing – produce higher gas velocity @ discharge tip of impeller

Helps impeller produce pressure at low load

Improve efficiency and stability



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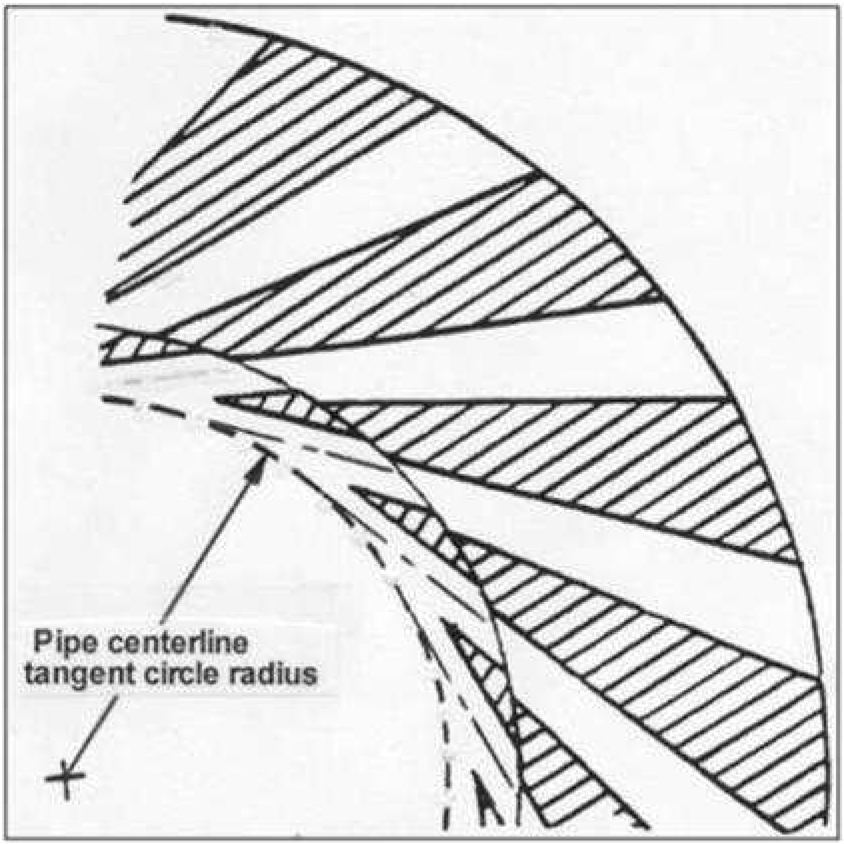
Compressor Theory



Closing diffuser helps the impeller by narrowing the passage through which the gas flows. In this way, the split ring diffuser helps the impeller produce pressure at low loads, thus improving efficiency and stability

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Compressor Theory

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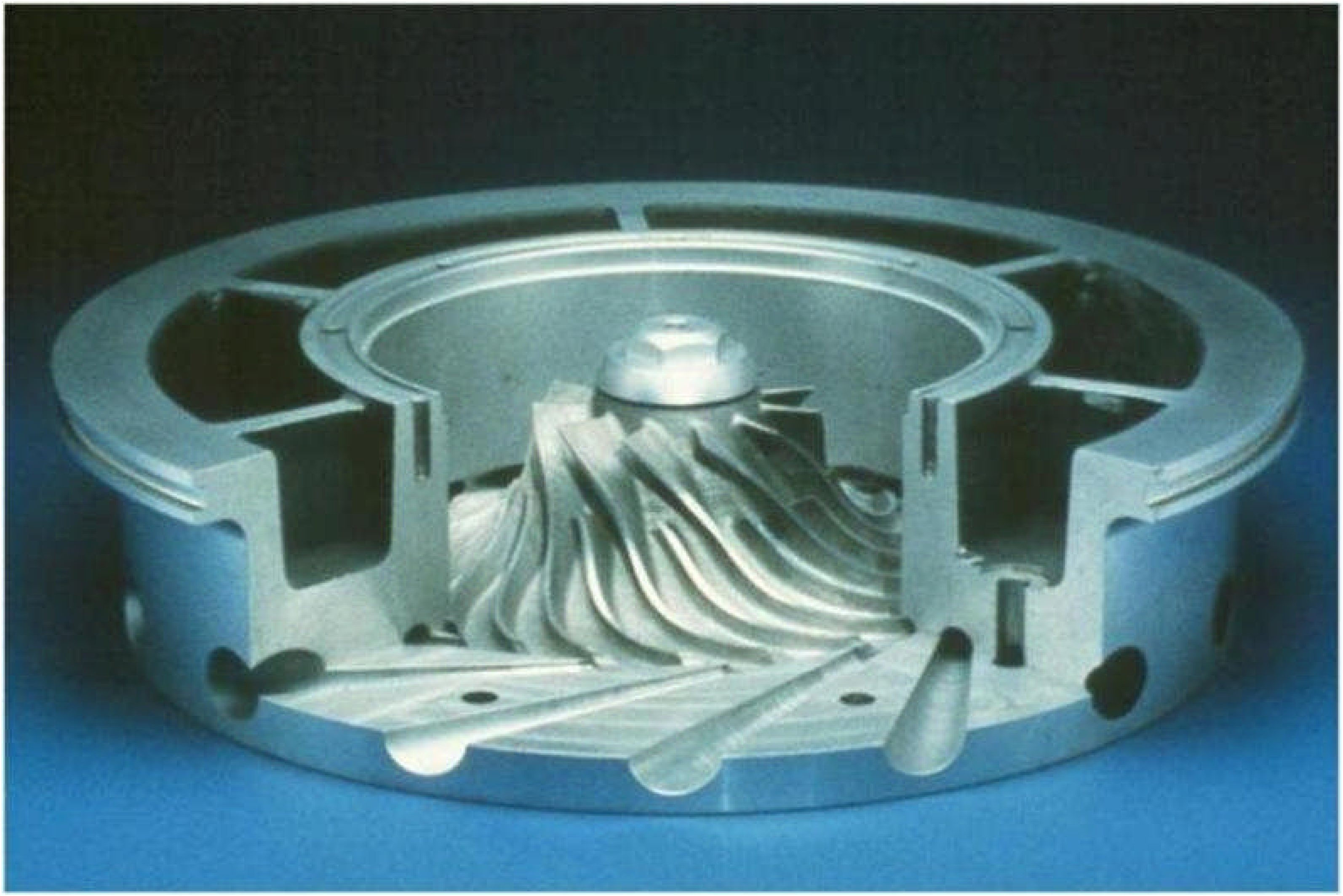
Compressor Theory



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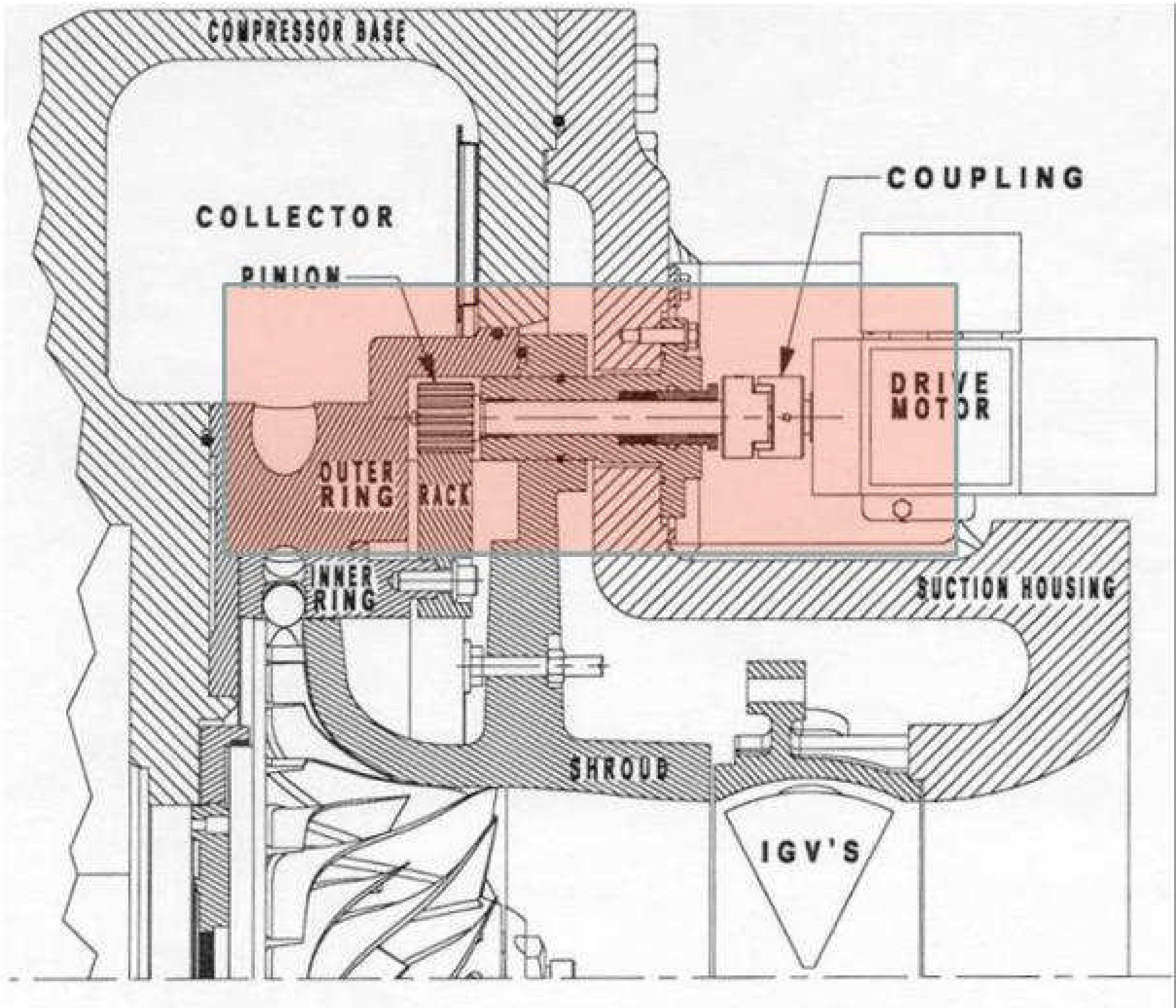
Diffuser Actuator



Compressor Cross section

19XR Frame 4 & 5 Compressors Only

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Diffuser Actuator

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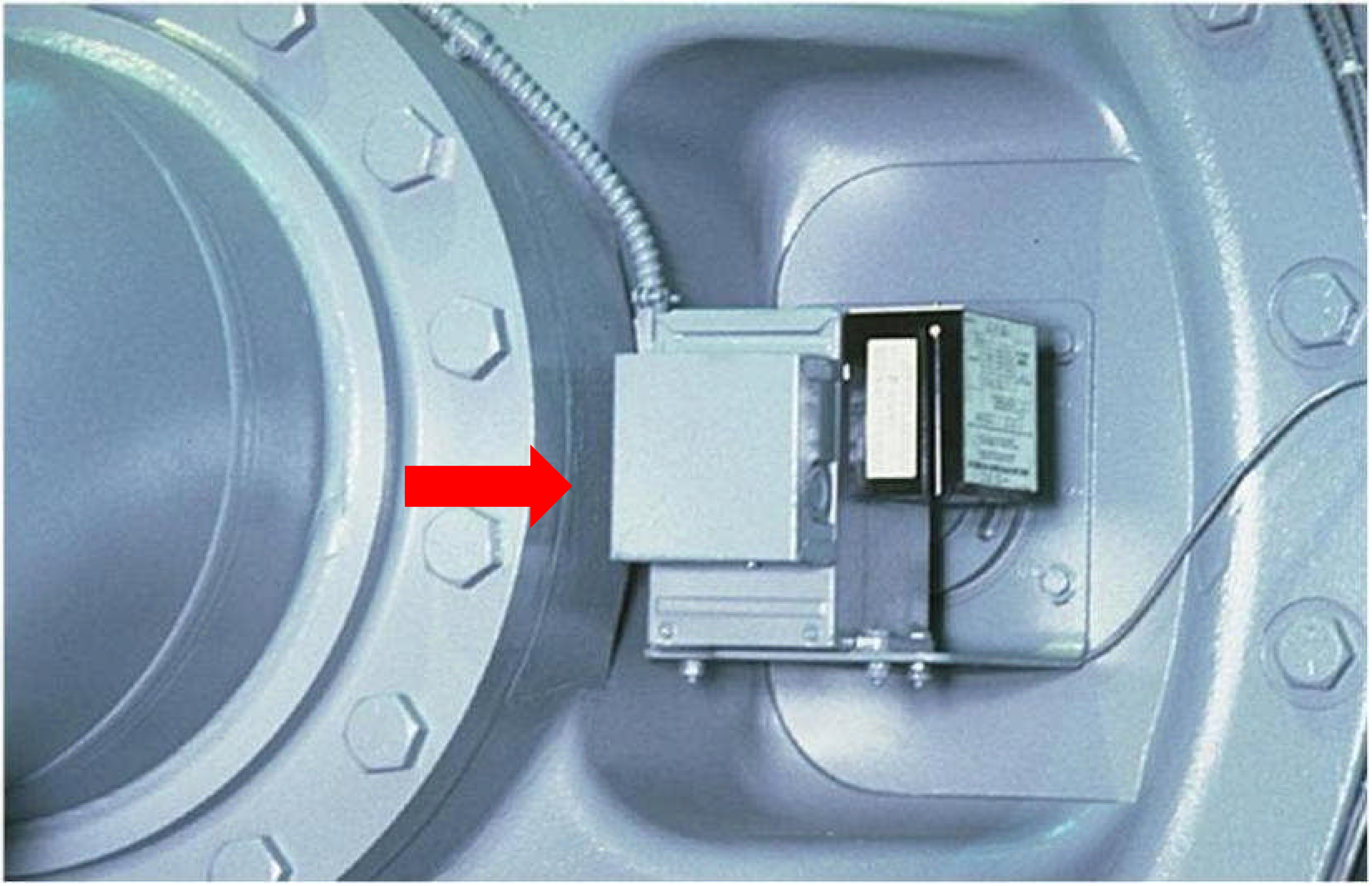

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Rotating Stall Transducer

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Refrigeration Cycle

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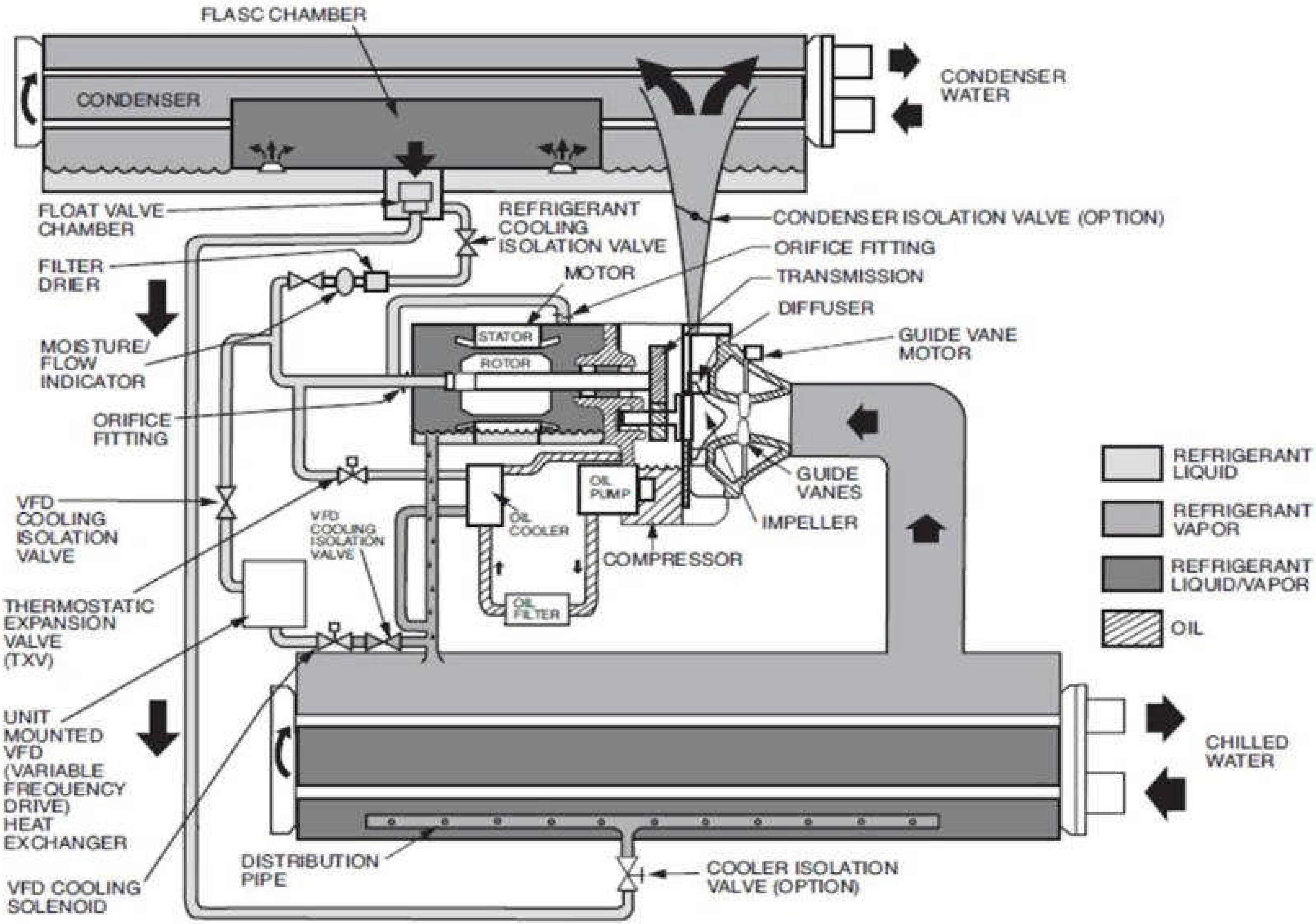


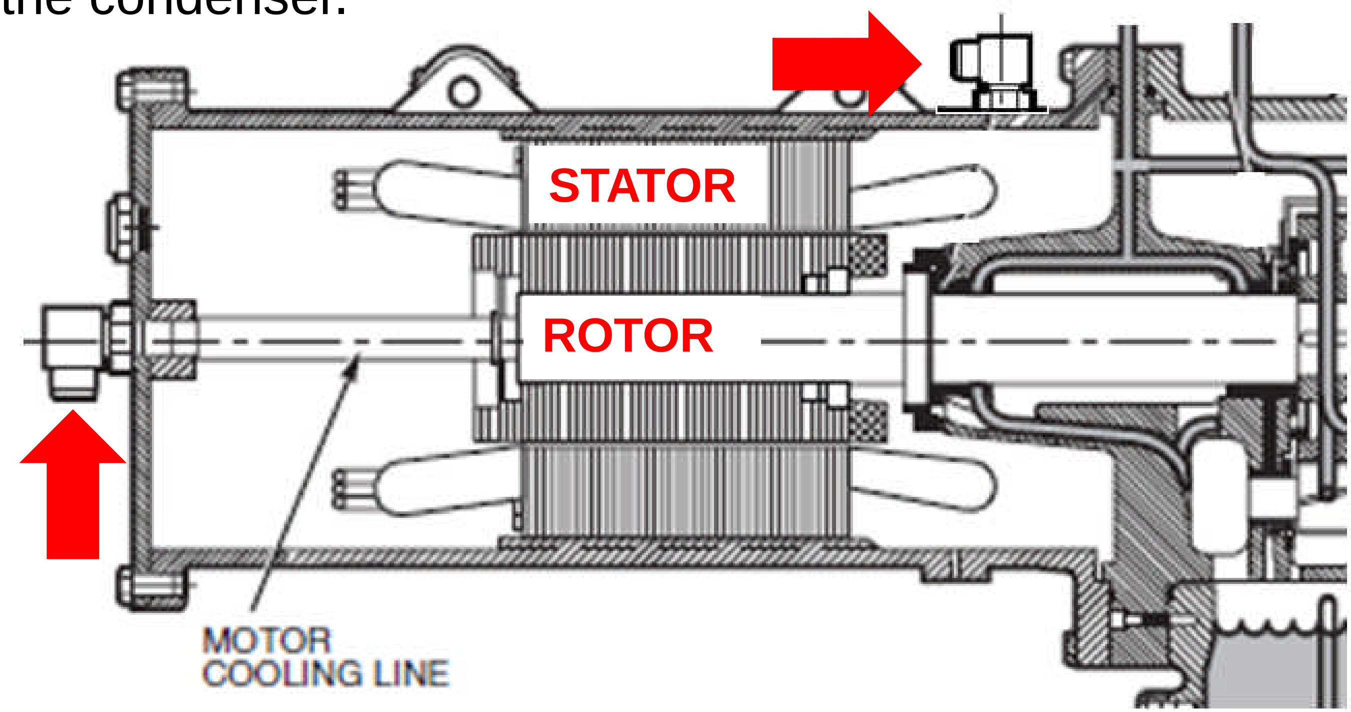
Motor cooling

The motor is refrigerant cooled.

Liquid is injected into the dam located on the rotor and travels through slots in the rotor to cool stator.

Liquid is sprayed on the end turns by a fitting located on top of the stator housing.

The refrigerant is filtered through a drier with isolation valves located on the bottom of the condenser.



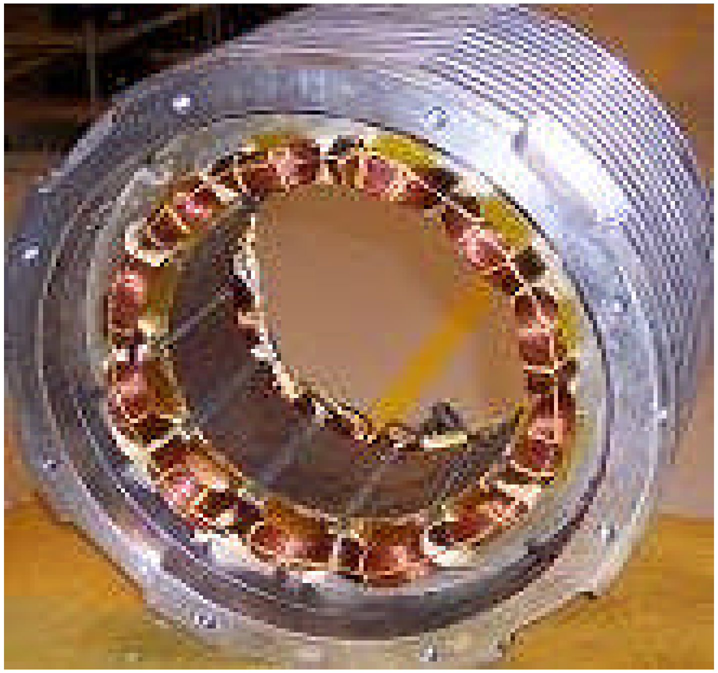
Motor Thermistors

The stator contains two 5K thermistors to sense motor temperature.

These thermistors are located on the motor end turns next to the transmission. One of the thermistors is a spare.

The motor area is vented to the evaporator, so it typically operates at 40-70ºF.

Two Motor Designs on 19XR



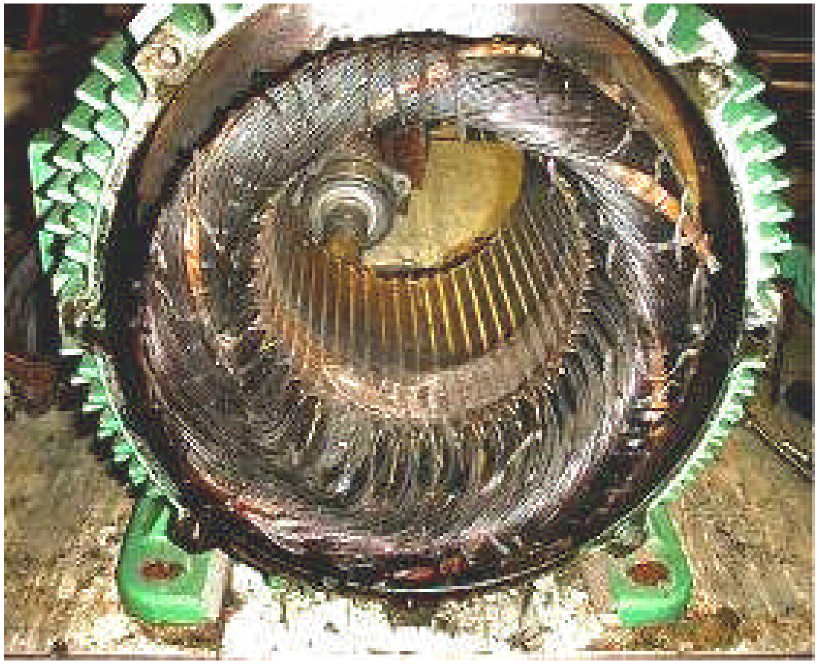
Form Wound

Winding individually formed and placed into stator slot.

Used in High voltage (2300V and above)

Better insulation on high voltage

Frame 5 only



Random Wound

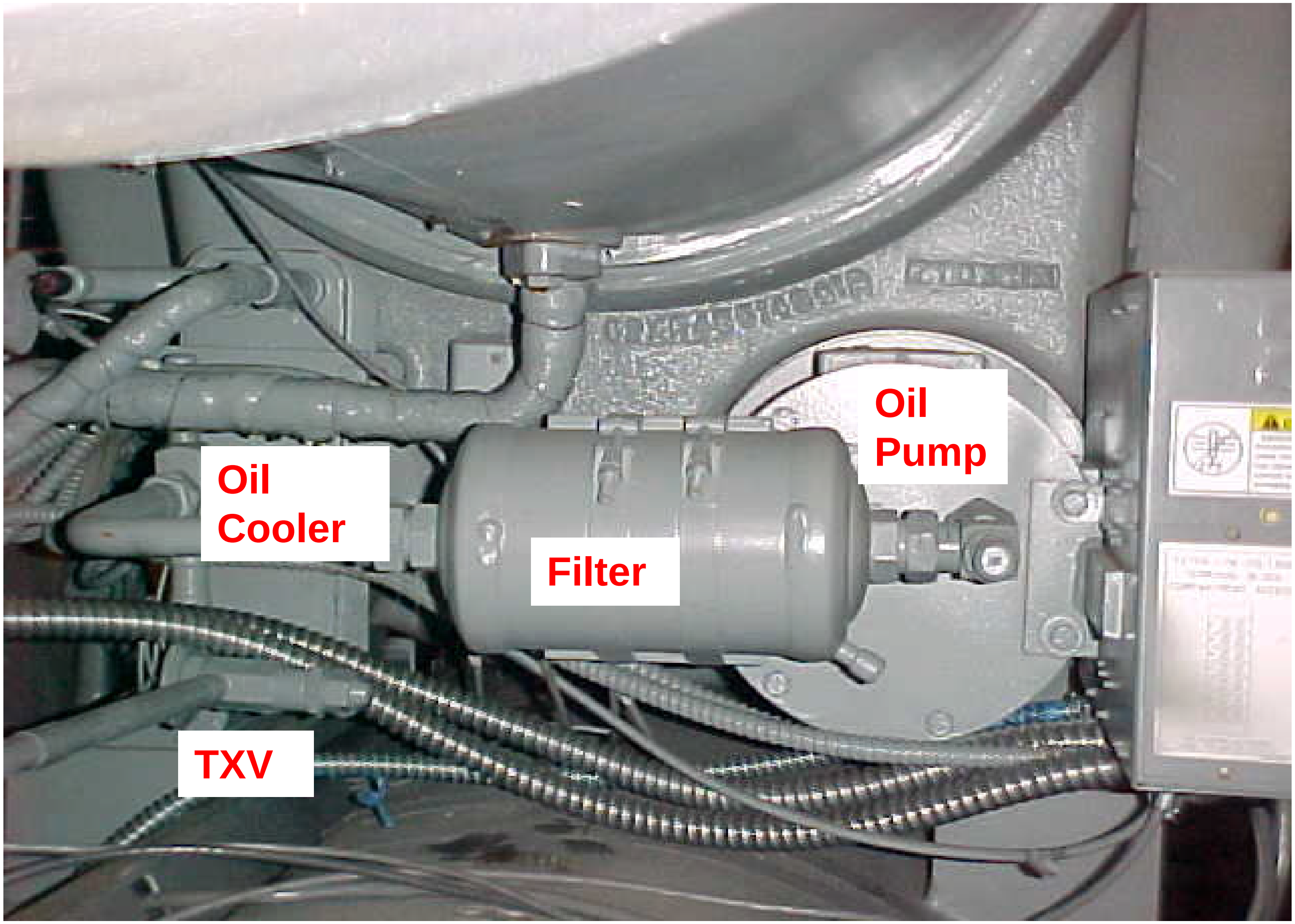
Standard type of stator winding used in motors under 1000 volts

Frame 2-4

Frame 5 (sometimes)

19XRV

Lubrication



19XRV

Lubrication

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The oil pump is a vane type design that is positive displacement.

15 micron filter is located on the discharge of the pump.

It provides lubrication to the two low speed bearings and the high speed assembly. The pressure is regulated by a relief valve in the Oil sump.

The temperature is regulated by a refrigerated oil cooler that maintains 110-120 degree f leaving oil temperature. With the system off, the oil heater maintains a temperature Of 140 degree f.

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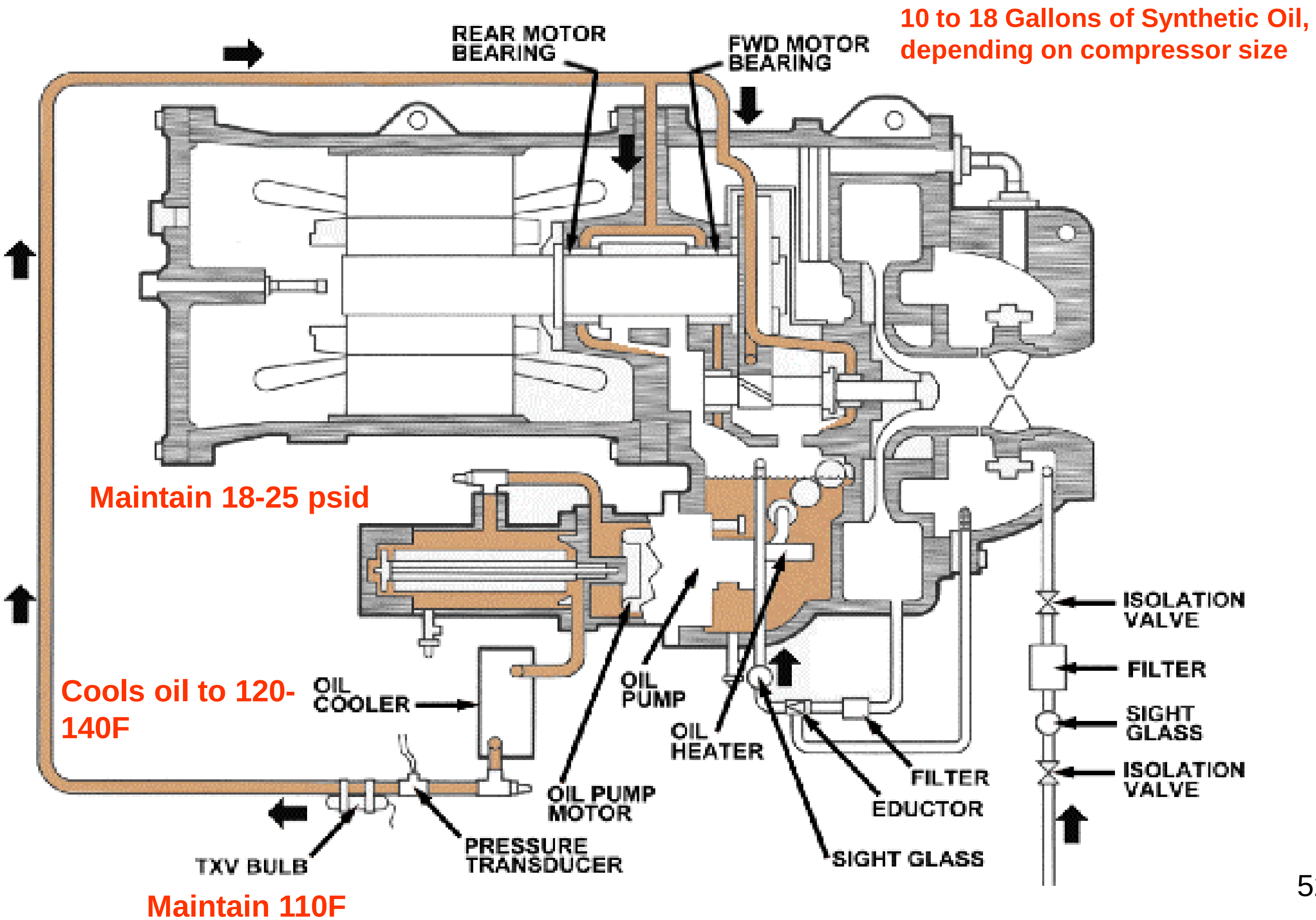
Lubrication



19XRV

Lubrication

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Oil Temp

Operating = between 125ºF and 150ºF

Shutdown

a) energize heater if sump < 140ºF or sump < cooler refrigerant temp + 53ºF

b) de-energize heater if sump > 152ºF or > 142ºF and > cooler refrigerant temp +55ºF

Start-up Delay = if Oil temp - Evap refrig temp is 50ºF or less, then startup is delayed until 50ºF or greater.

NOTE: Oil heater is OFF during start-up or during compressor run.

19XRV

Lubrication (continue)

Oil Pressure

Oil Pressure Relief valve maintains 18–30 psid or 18-40 psid for rolling element bearings

Oil Discharge Press. - Oil Sump Press. (transducers)

NOTE: If Oil Pressure < 15 PSID, then compressor will shutdown.

Oil Pump

@ Start-up = energizes providing 45 sec of pre-lube to bearings after pressure verification.

During Shutdown = continues to operate for 60 sec for post-lube.

Shutdown = energizes for 30 sec for every 30 mins that the oil heater is energized to stir oil sump and therefore reduce refrigerant entrained in oil.

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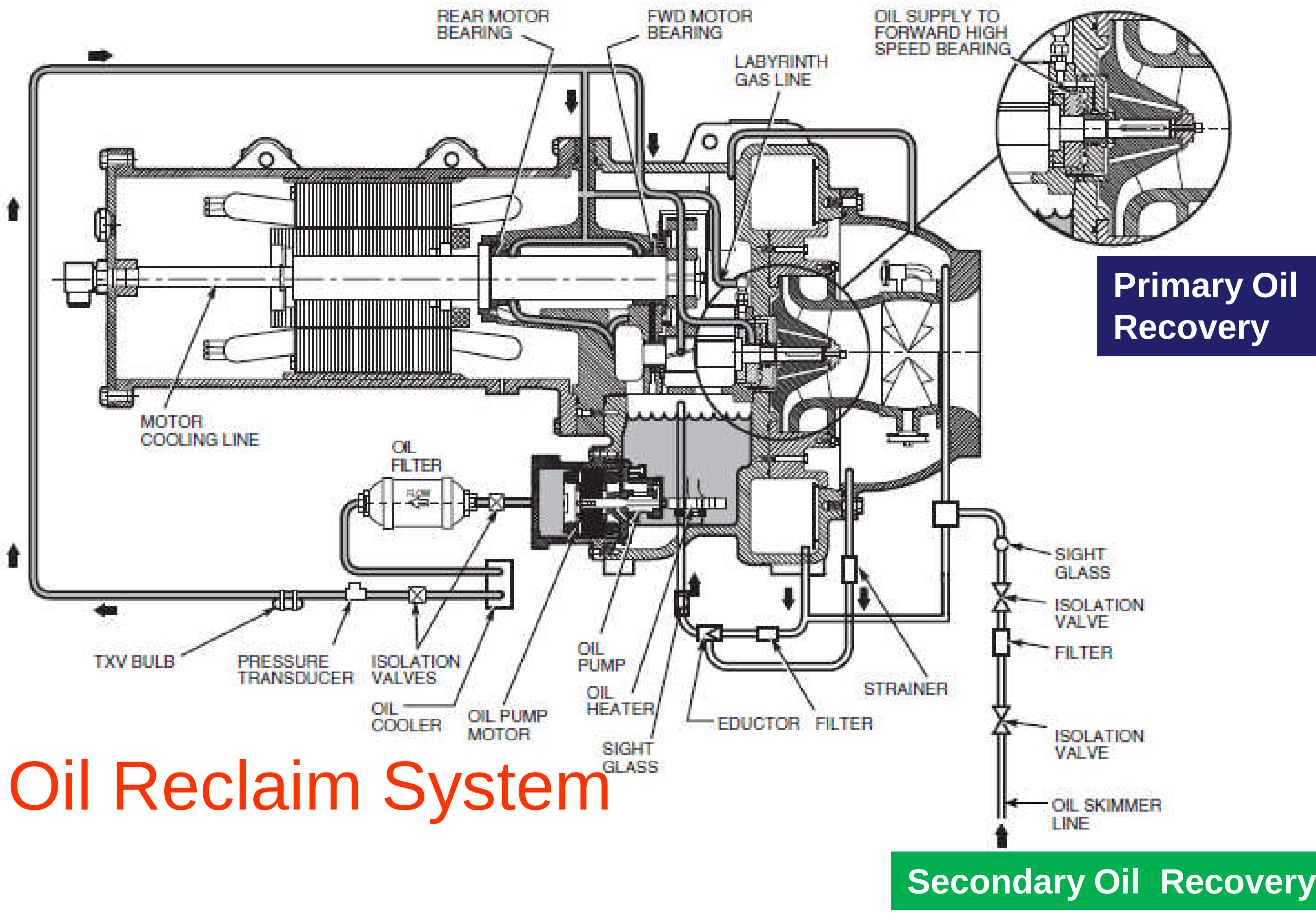
Compressor Oil Recovery



Oil Reclaim System

19XRV

Oil Recovery NEW DESIGN dual eductor

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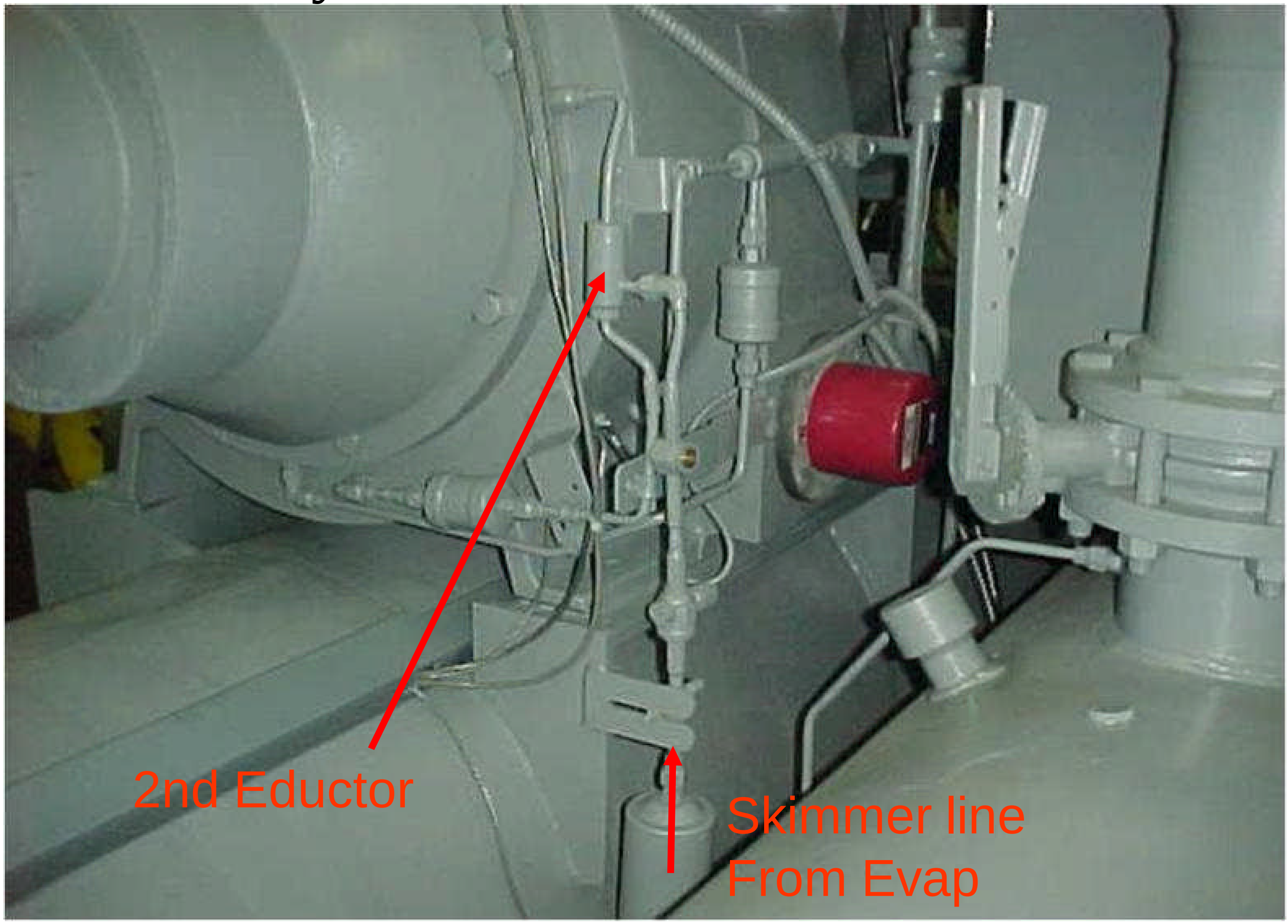

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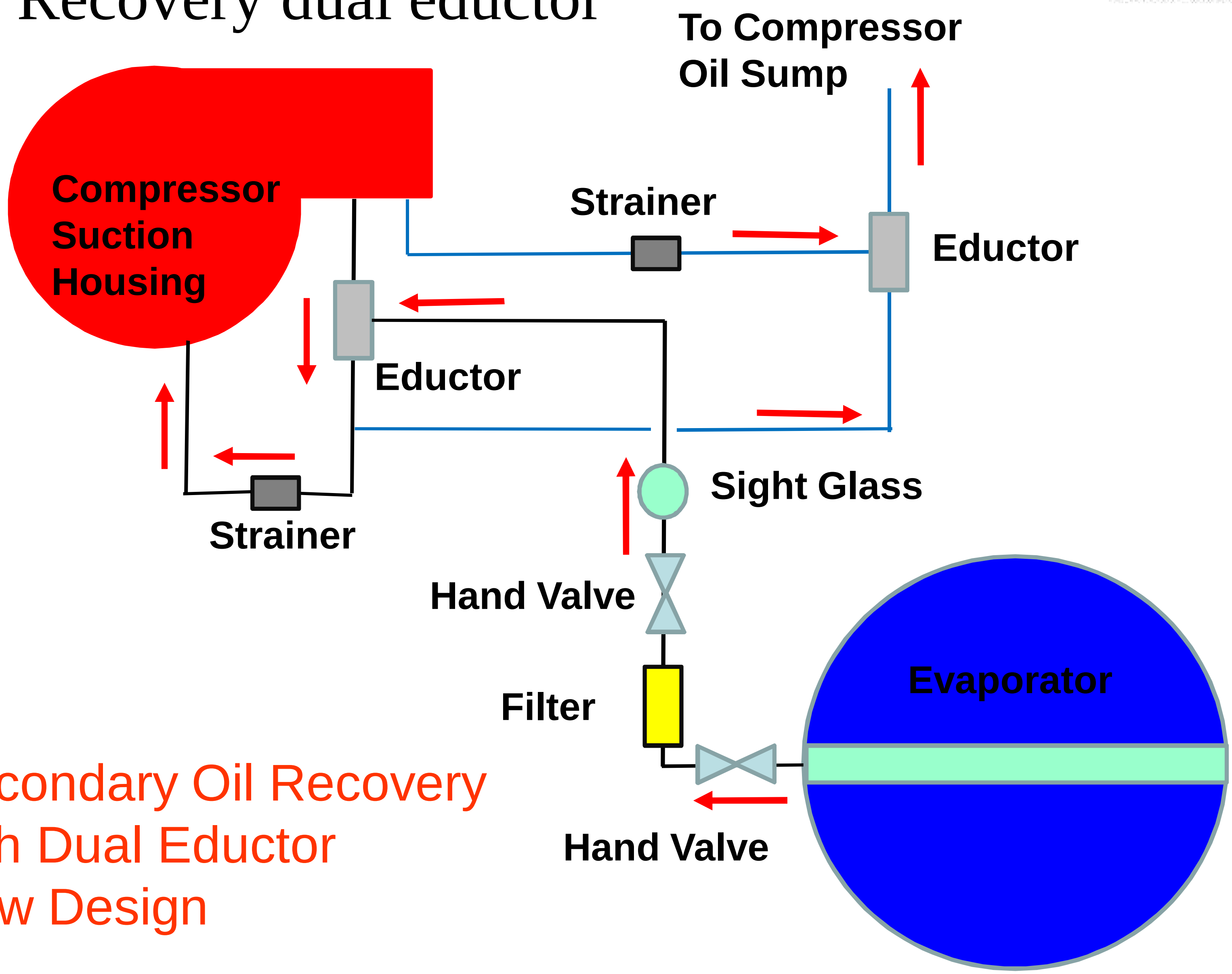
Oil Recovery dual eductor



Secondary Oil Recovery
with Dual Eductor
New Design

19XRV

Oil Recovery NEW DESIGN dual eductor

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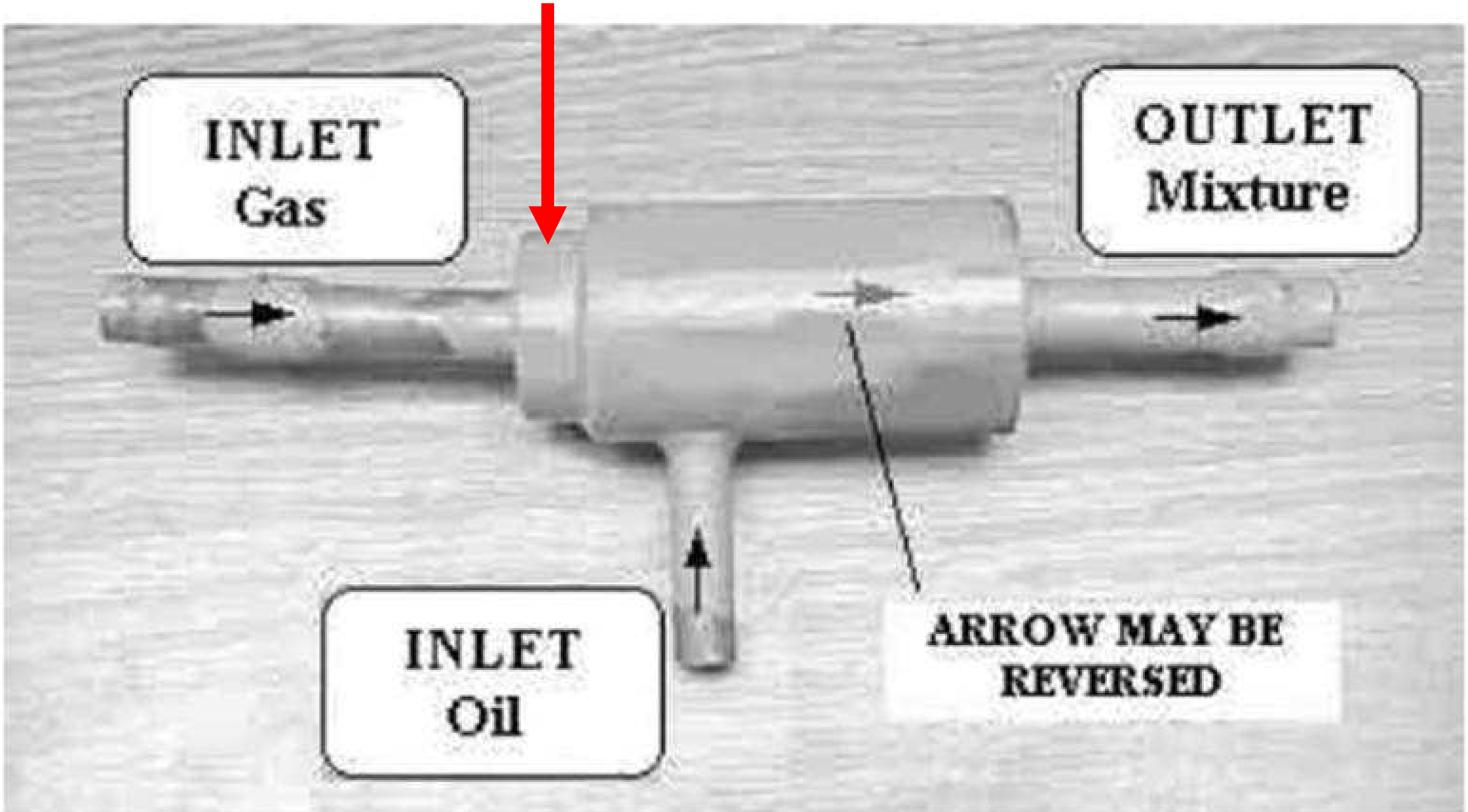
	OLD	NEW (Dual Eductor)
Primary Oil Recovery Mode	Oil travel with refrigerant into suction housing where educator transports recovered oil to oil sump from suction housing	SAME
Secondary Oil Recovery Mode	Under **ANY** conditions oil/refrigerant mixture is removed from top of liquid level in evaporator by educator. Oil/refrigerant mixture is carried to suction housing where educator transports mixture to oil sump	Under **LIGHT LOAD conditions** (IGV closed creating pressure differential) causing oil/refrigerant mixture to be removed from top of liquid level in evaporator. Oil/refrigerant mixture is carried to suction housing where educator transports mixture to oil sump

19XRV

Eductor – Correct flow

Small diameter
is Inlet side



Lubrication

Oil Level

Operating = visible in one of two sight glasses

Shutdown = visible between middle of upper glass and top of lower.

Maximum oil level when not running

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High Speed Bearings

Kingsbury thrust design

Rolling element bearing

- On all Frame 3 compressor starting sometime mid-2001. Call engineering to check
- Frame 4 compressor starting week 25 2011 (see bulletin SB-C1103)
- Frame 5 compressor starting week 1 2011 (see bulletin SB-C1103)

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High Speed Bearings

- On all Frame 3 compressor starting sometime mid-2001. Call engineering to check
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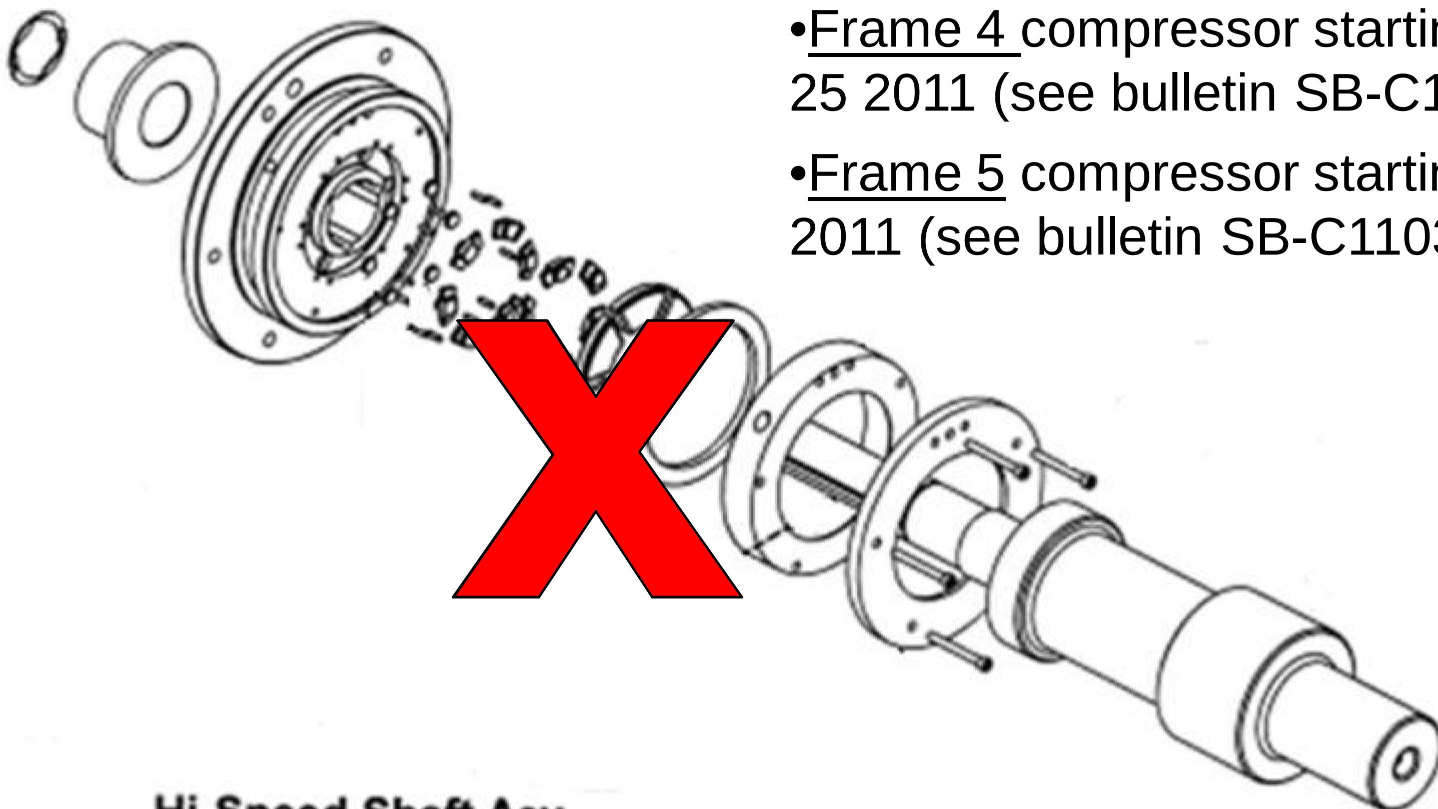

Hi-Speed Shaft Asy

Compressors Without Roller Element Bearings

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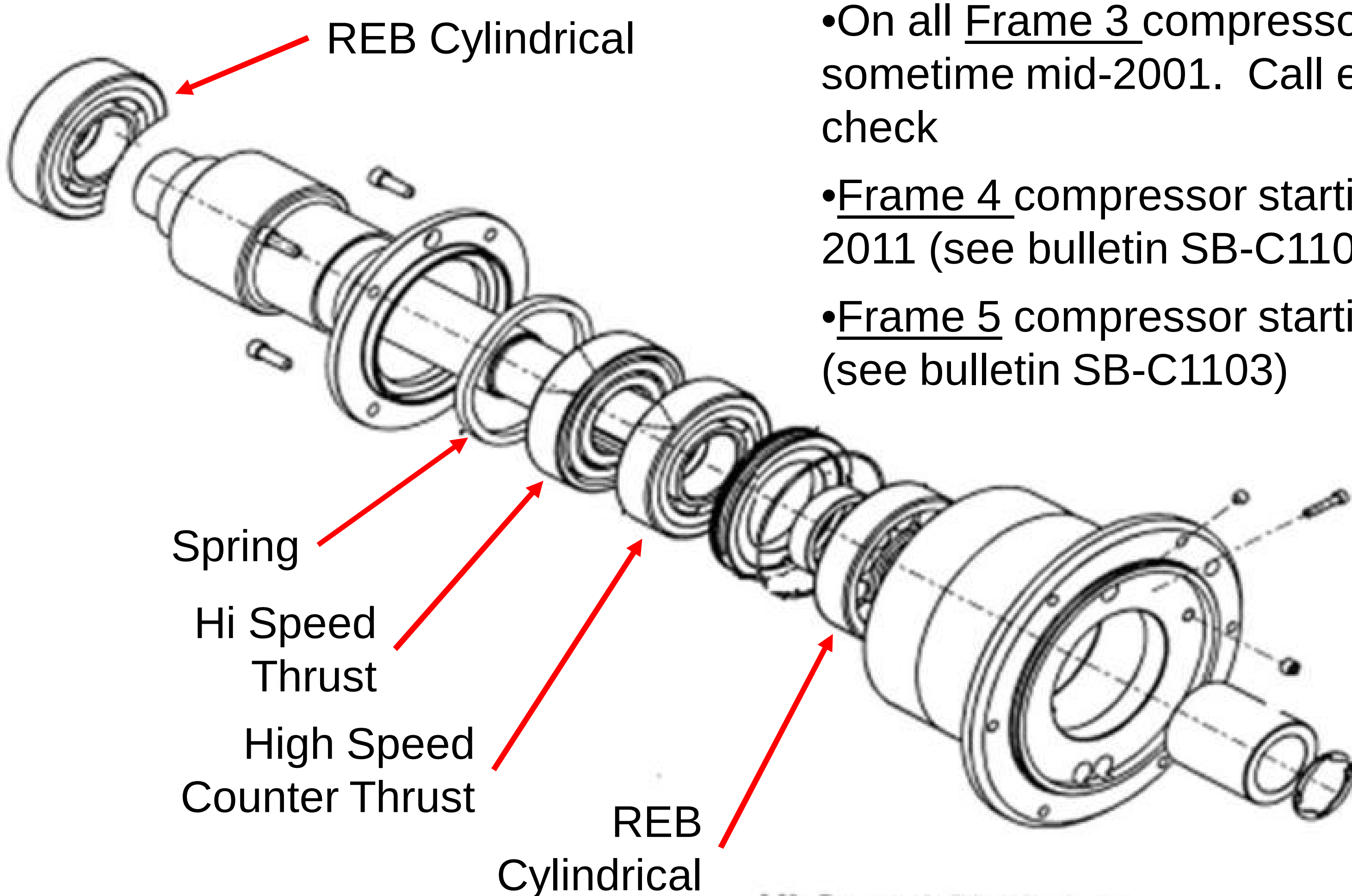
High Speed Bearings

•On all Frame 3 compressor starting sometime mid-2001. Call engineering to check

•Frame 4 compressor starting week 25 2011 (see bulletin SB-C1103)

•Frame 5 compressor starting week 1 2011 (see bulletin SB-C1103)



Hi-Speed Shaft Asy

Compressors With Roller Element Bearings

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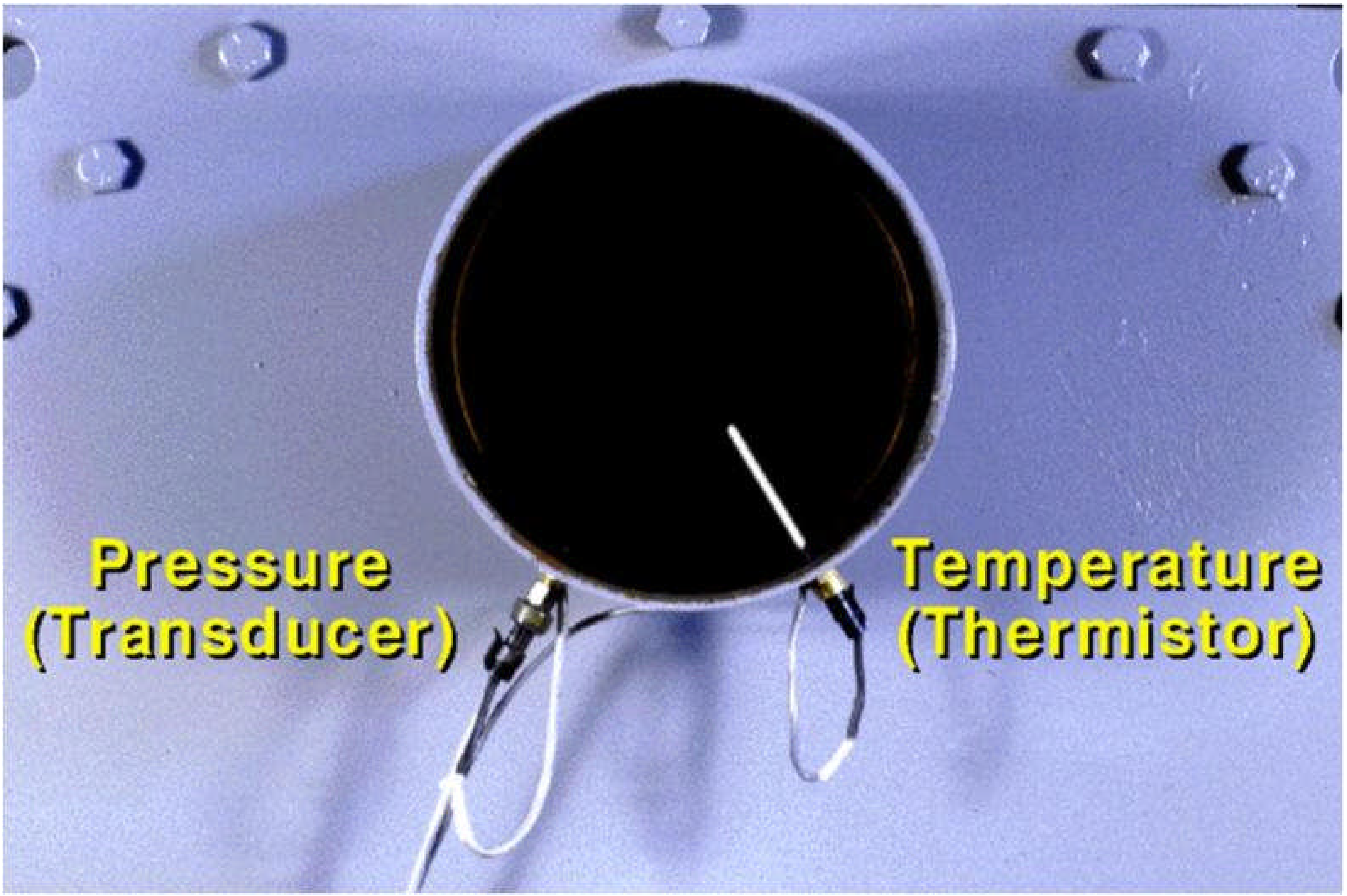
Sensors & Transducers

Two types of sensors

1. Temperature sensors with wells. This sensor cannot be separated from its cable, but the sensor can be removed from well without breaking info fluid boundary
2. Thermistor. This sensor is installed within compressor for motor windings or thrust bearing temp. There is 1 spare sensor

Sensors & Transducers



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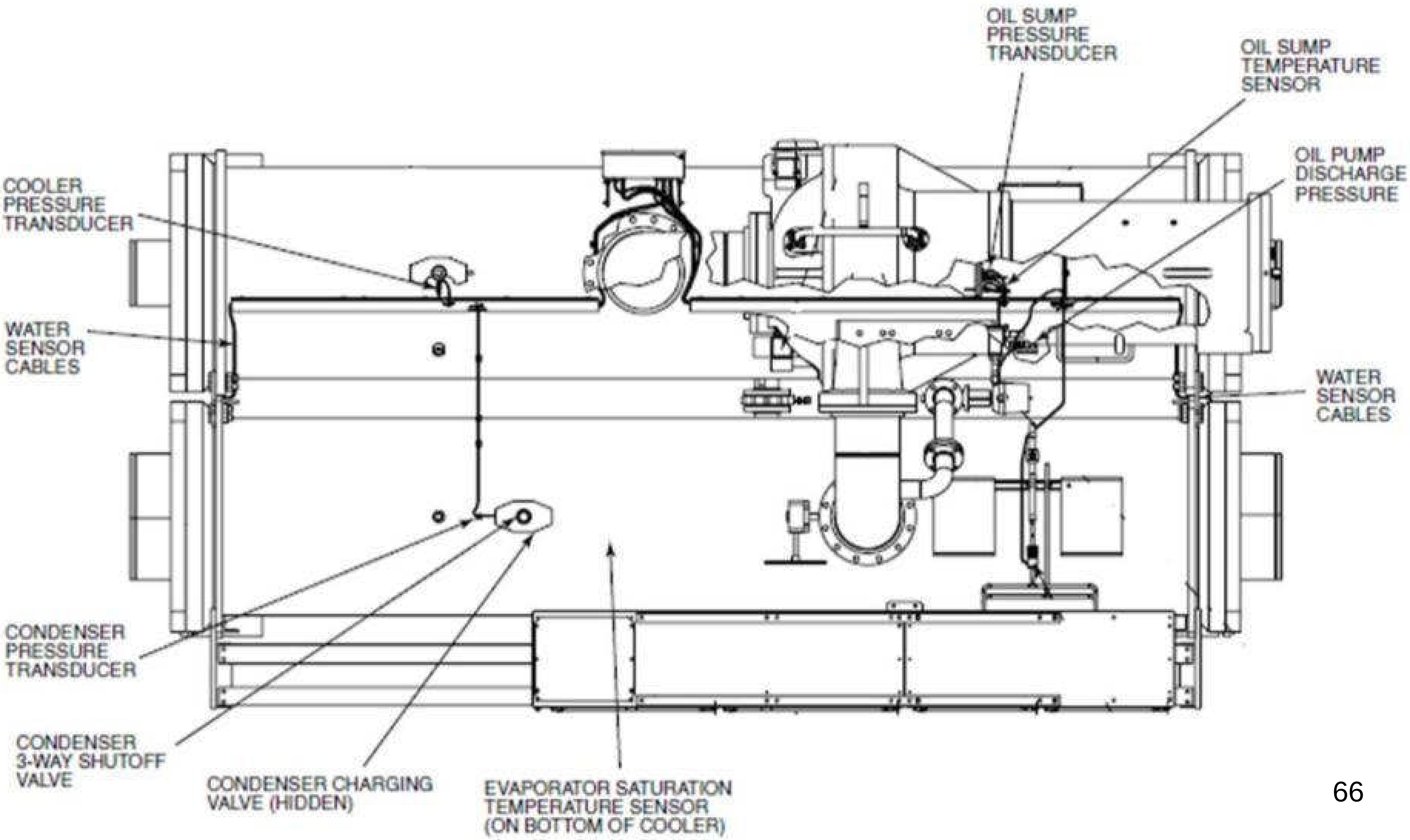
Sensors & Transducers



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Sensors

TYPE	LOCATION MONITORED	REMARKS
Temperature	Entering chilled water	Cooler inlet nozzle
	Leaving chilled water	Cooler outlet nozzle
	Entering condenser water	Condenser inlet nozzle
	Leaving condenser water	Condenser outlet nozzle
	Evaporator saturation	Sensor well on bottom of evaporator
	Compressor discharge	Compressor volute
	Oil sump	Compressor oil sump
	Compressor thrust bearing	Redundant sensor provided
	Motor winding	Redundant sensor provided

Total 10 temp sensors

8 functioning sensors

2 spares for thrust bearing and motor winding

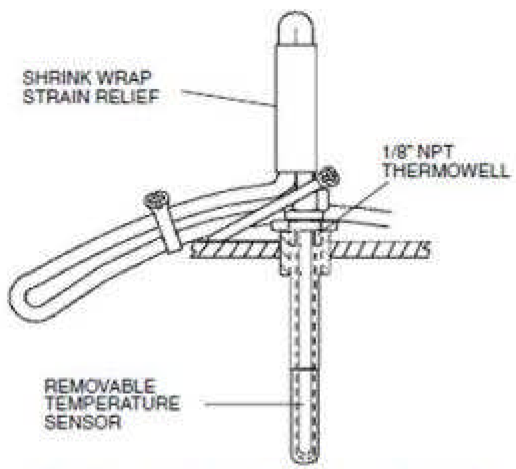

Fig. 12 — Temperature Sensor Used With Thermal Well

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Evaporator Flow

Mounted at the base of evaporator and senses refrigerant temperature directly

Uses evaporator saturation temperature in place of flow metering device

Chiller determines there is **flow** in cooler if:

- Evap saturation temp is higher than 1ºF above evap refrigeration trippoint
- Evap refrigeration temp is greater than evap refrigeration trippoint

Chiller determines there is **no flow** in cooler if

- Evap saturation temp lower than 1ºF below evap refrigeration trippoint
- Evap refrigeration temp <evap refrigeration trippoint and evap app > evap app alert threshold

Condenser Flow

Chiller determines there is **flow** in condenser if:

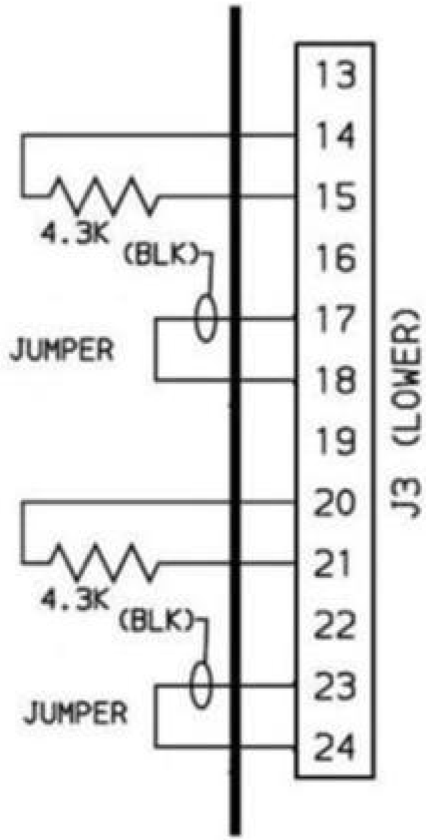
- Condenser pressure <165 psig
- Condenser pressure do not exceed configured condenser pressure override threshold by more than 5psi

Chiller determines there is **no flow** in condenser if

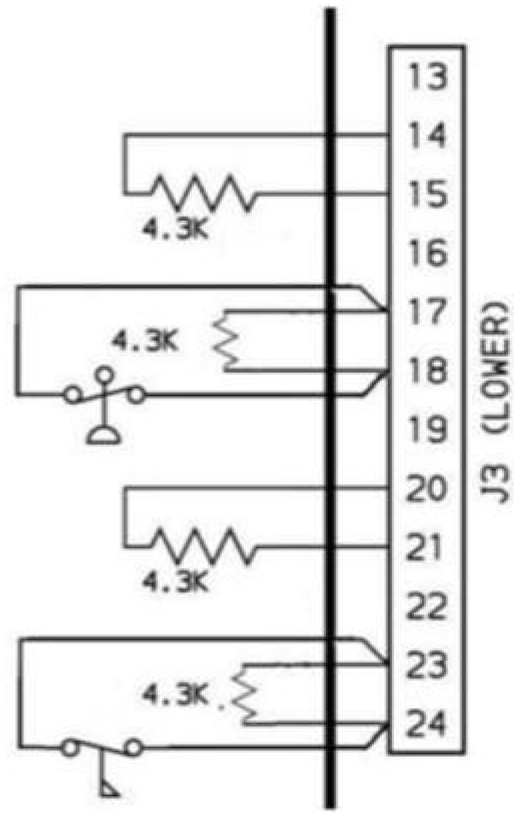
- Condenser pressure > 165 psig
- Condenser pressure exceeds configured condenser pressure override threshold by more than 5psi

Optional Flow Switch Wiring

No Flow Switches



Optional Flow Switches



CCM

***These devices are not supported by* the chiller warranty**

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Transducers

Pressure	Evaporator	Relief valve tee
	Condenser	Relief valve tee
	Oil sump	Compressor oil sump
	Oil sump discharge	Oil pump discharge line
	Diffuser (Compressor internal)	Only in machines equipped with split ring diffusers
	Entering chilled water (Optional)	Cooler inlet nozzle
	Leaving chilled water (Optional)	Cooler outlet nozzle
	Entering condenser water (Optional)	Condenser inlet nozzle
	Leaving condenser water (Optional)	Condenser outlet nozzle
Angular Position	Guide vane actuator	Potentiometer inside of actuator
	Split ring diffuser actuator (Optional)	Potentiometer inside of actuator only on machines equipped with split ring diffusers (split ring diffuser position not displayed on ICVC)
Pressure Switch	High condenser (discharge) pressure	Compressor volute, wired into the VFD control circuit
Temperature Switch	Oil pump motor winding temperature	Wired into the oil pump control circuit

Total 5 pressure transducer

1 pressure switch

1 temperature switch

1 actuator (Frame 2,3,4 w/o split ring diffuser)

2 actuators (Frame 4 & 5 with split ring diffuser)

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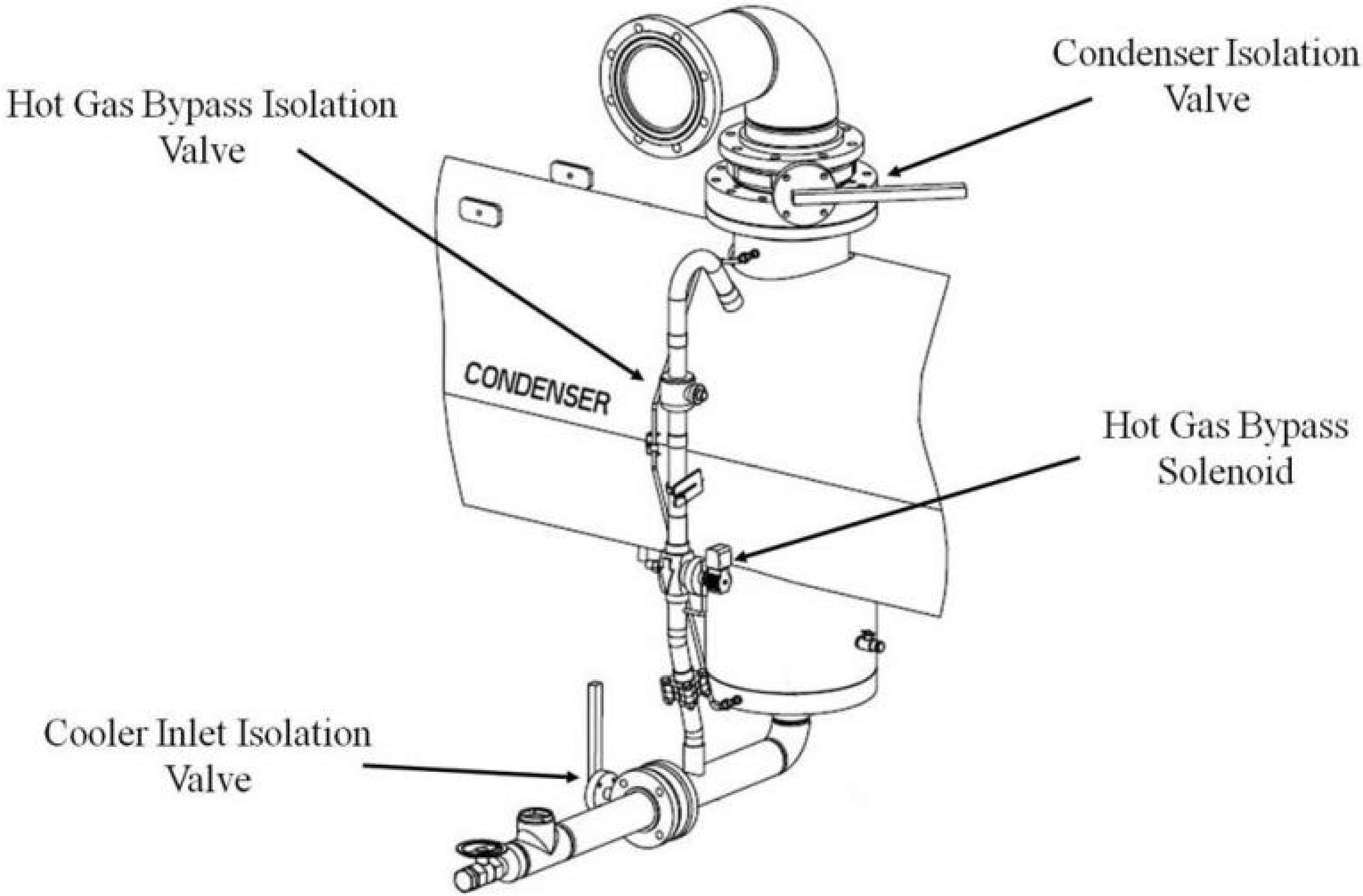
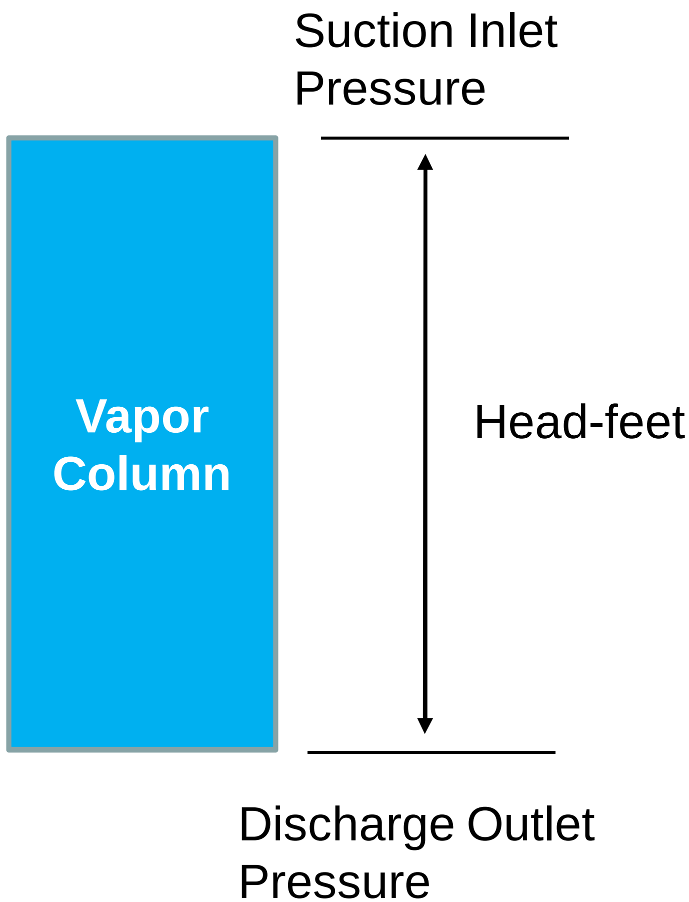
Optional: Hot gas bypass



Compressor Theory



Head

Imaginary column of refrigerant vapor, measure of pressure rise developed by centrifugal compressor

Pressure at discharge minus pressure at suction

Directly affected by entering water temperature from cooling tower

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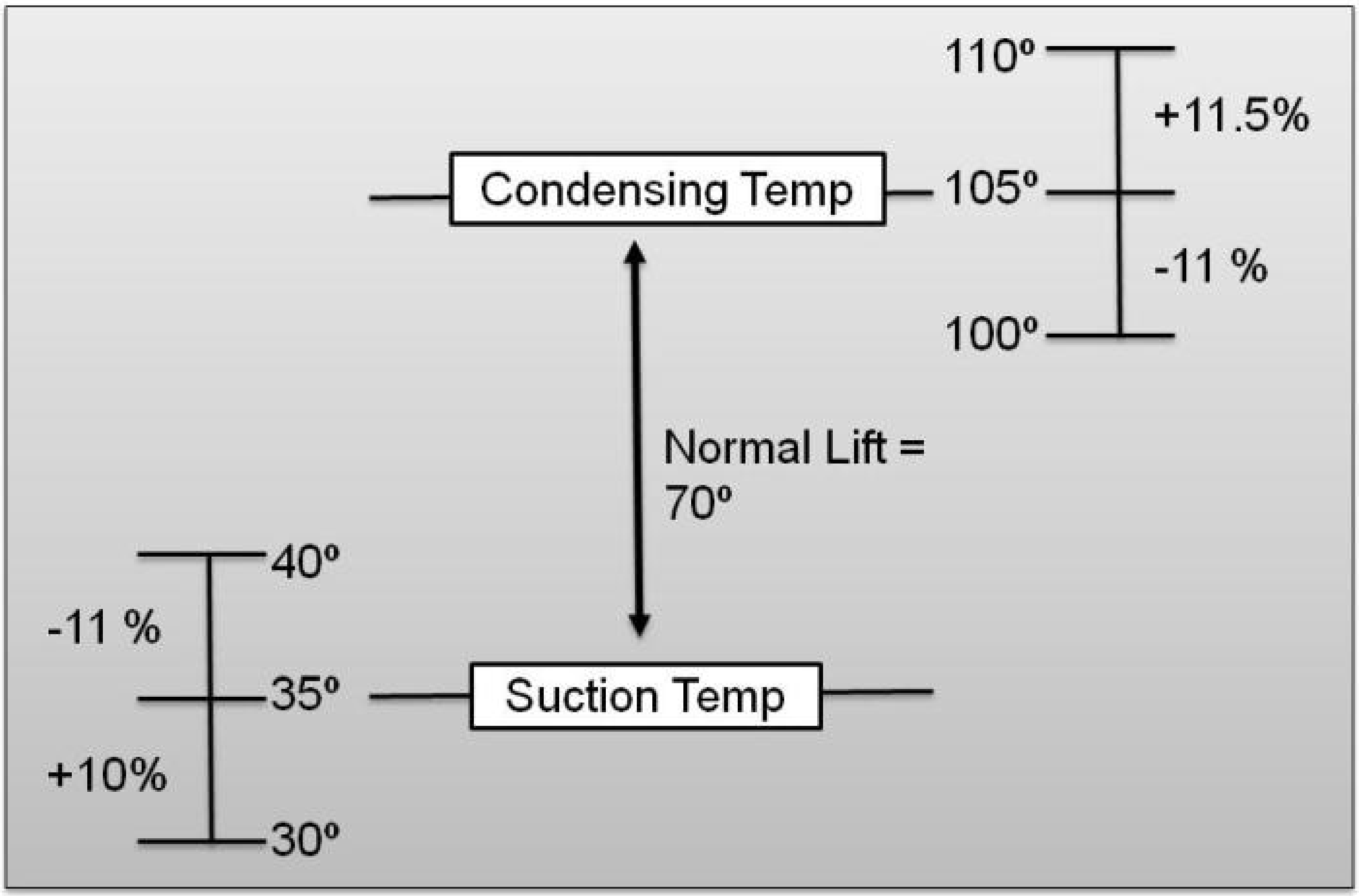
What is Lift

Ability of compressor to lift refrigerant gas from cooler saturated suction temperature level to condenser saturated discharge temperature level, measured in ºF



Compressor Theory

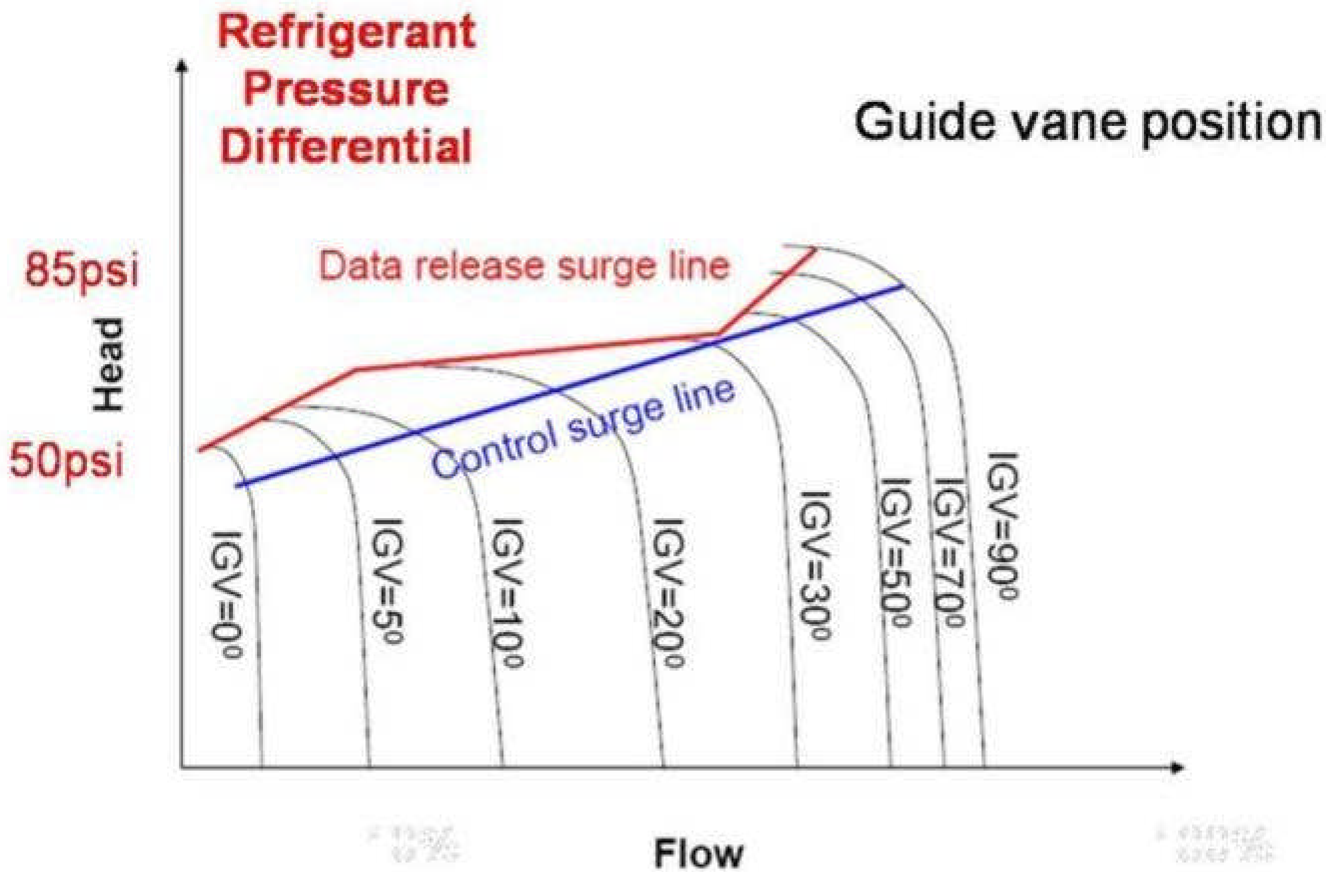
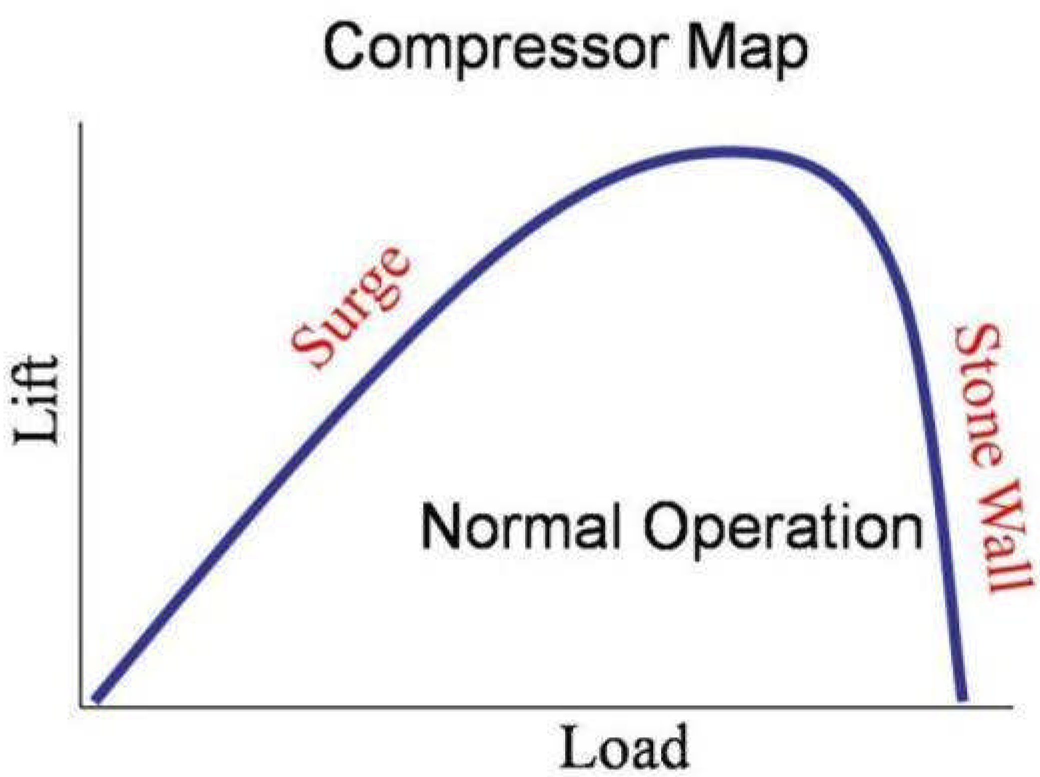


Chart-Performance of centrifugal compressor
Head output is a function of speed and inlet volume

Compressor Theory



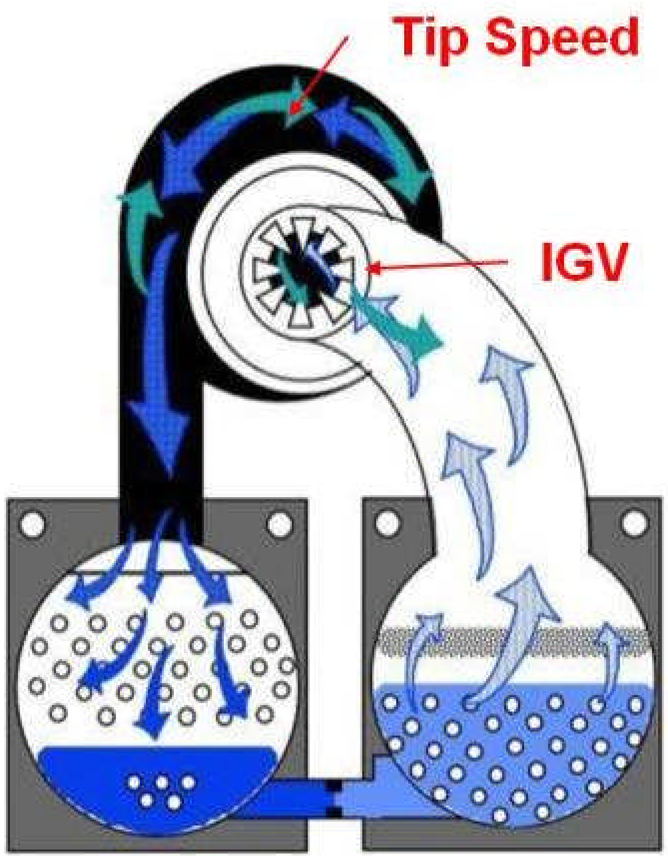
Choke/Stonewall

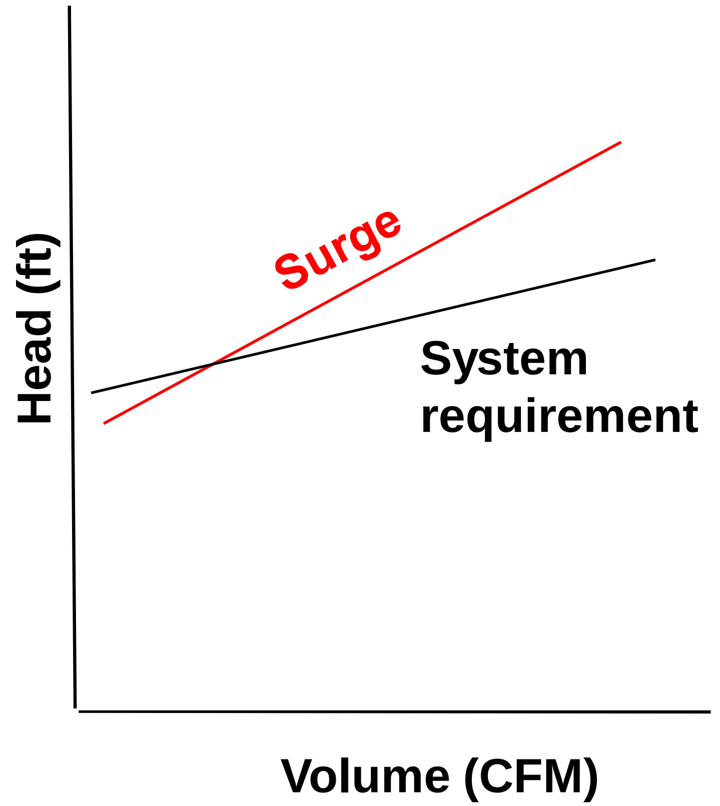
- Capacity of an impeller
- Maximum capacity
- Compressor cannot maintain required flow to maintain lift

Stall/Surge – insufficient flow result

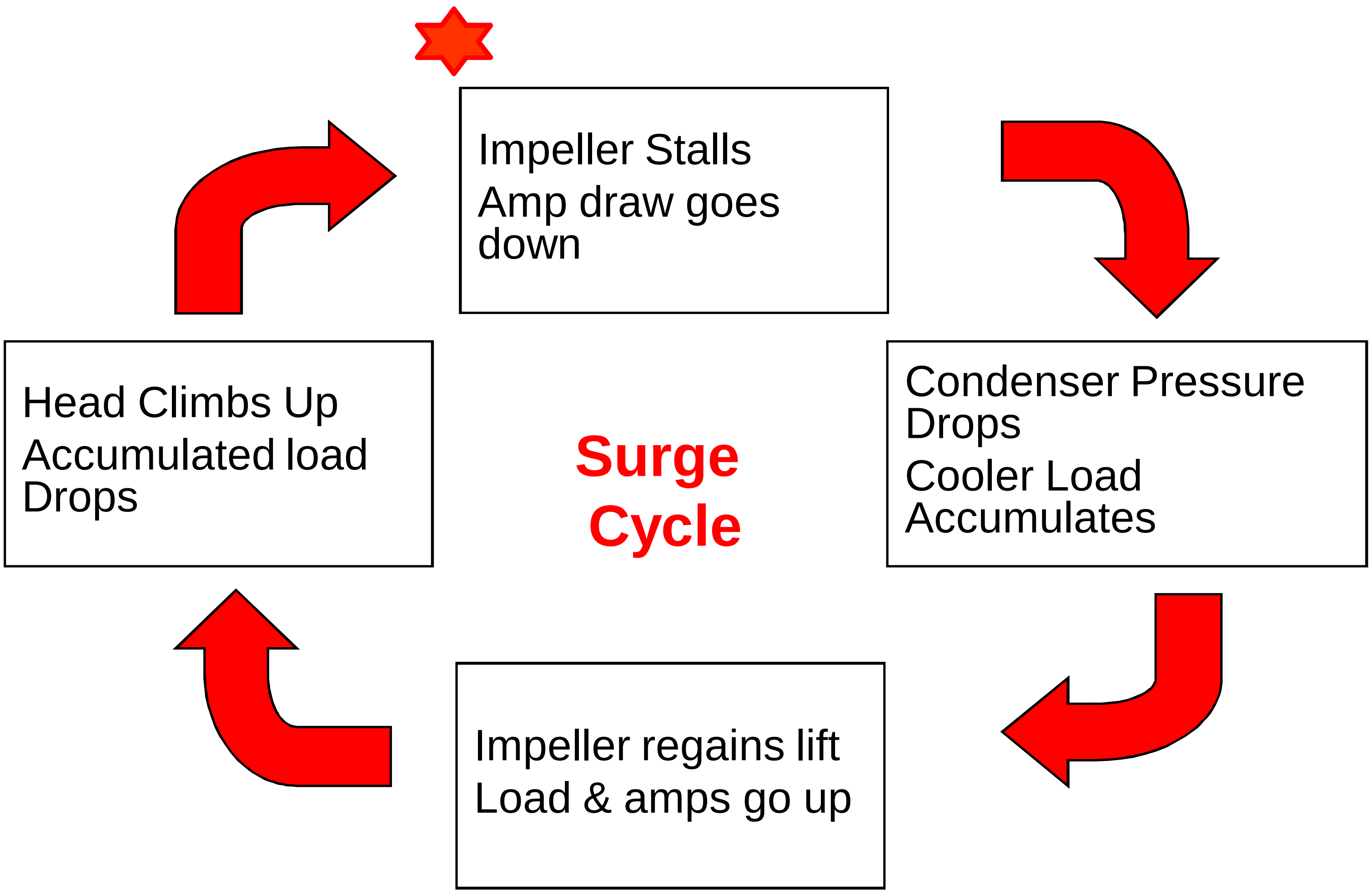
What is Surge ?

Momentary reversal of gas flow caused by the inability of compressor to make required 'lift' for the available load

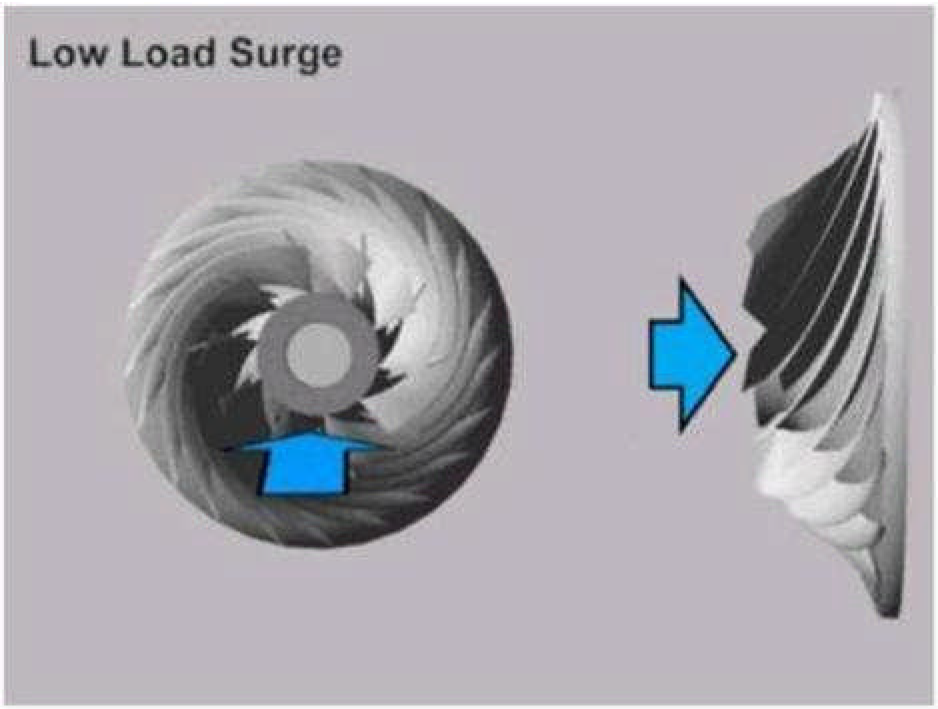




What is Surge ?



Surge – Cooler Low Suction Press Surge



Low Refrigerant Level
- Low Charge
- Float Valve Restriction

Low Chilled Water Flow
- Bypass Division Plates
- Dirty/Blocked Tubes
- Air in Water Lines
- Dirty Strainer
- Pump/Valves

Carryover
- Excessive Oil in Refrigerant
- Overcharge of Refrigerant

Load Changes
- Hot Gas Bypass Malfunction
- Rapidly Changing Load

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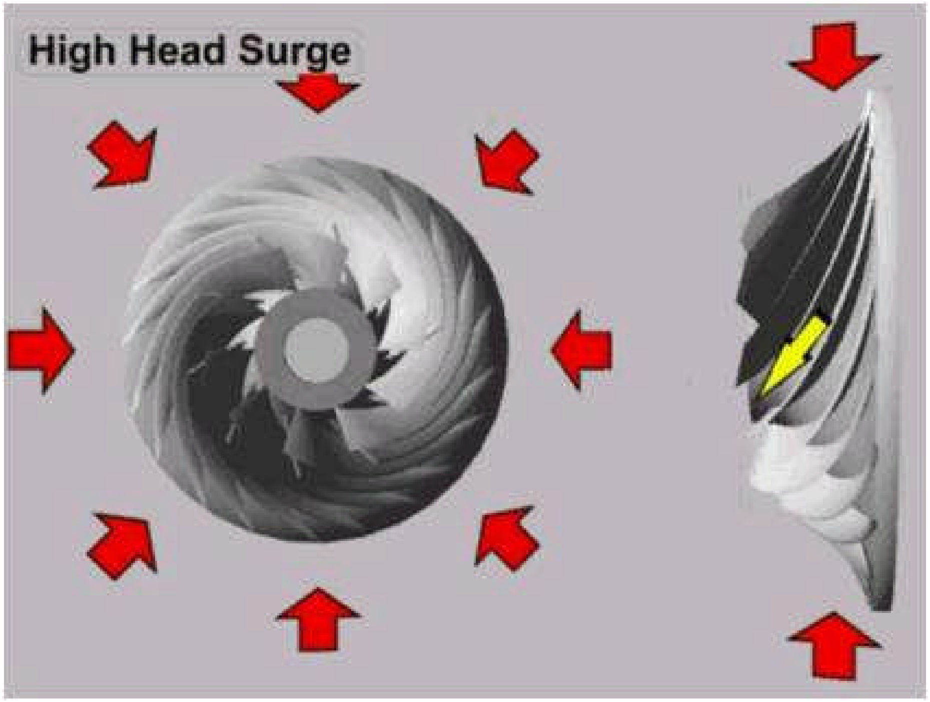
Surge – Condenser High Head Press Surge



Air in Machine

High Entering Water Temperature
- Low Water Flow
  - Bypass Division Plate
  - Blocked Tubes
  - Air in Water Lines
  - Dirty Strainer
  - Pump/Valves
- Poor Tower Operation
  - Fan Control Improperly Set
  - Bypass Water/Air
  - Strainer Plugged
  - Fan Pitch

Dirty or Scaled Tubes

Wrong Refrigerant Charge

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Surge – Compressor

Excessive Impeller clearance

Failed impeller

Wrong Impeller selection

Low Speed - Low Voltage

Inlet Guide Vanes Closed

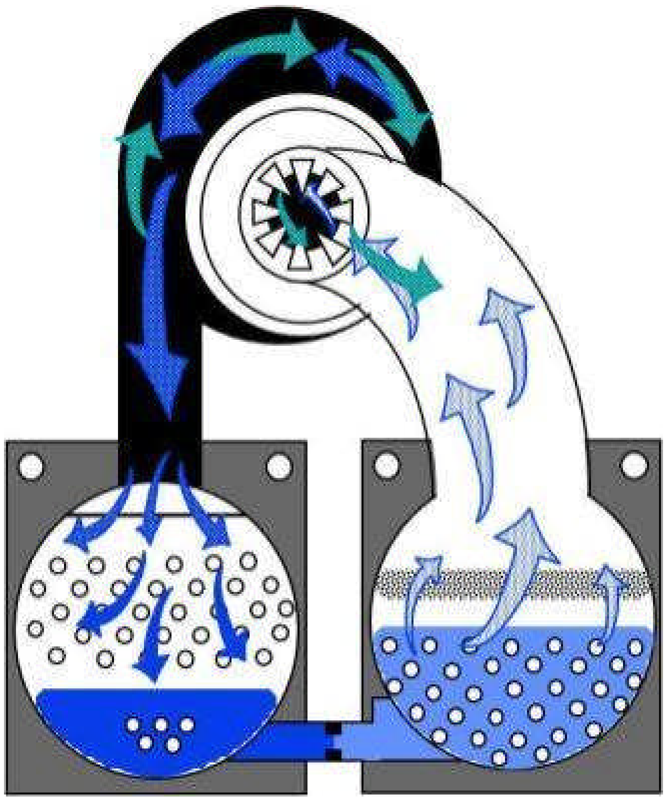
Chiller Surge Protection

Turn to the Experts.

Shutdown will be initiated when > 5 surge counts have occurred within an operator-specified time

With VFD machines a surge count will increase speed by the configured % amount (VFD INCREASE STEP).

While the SURGE PROTECTION COUNTS are > 0, a speed decrease will not be honered.



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Chiller Surge Protection

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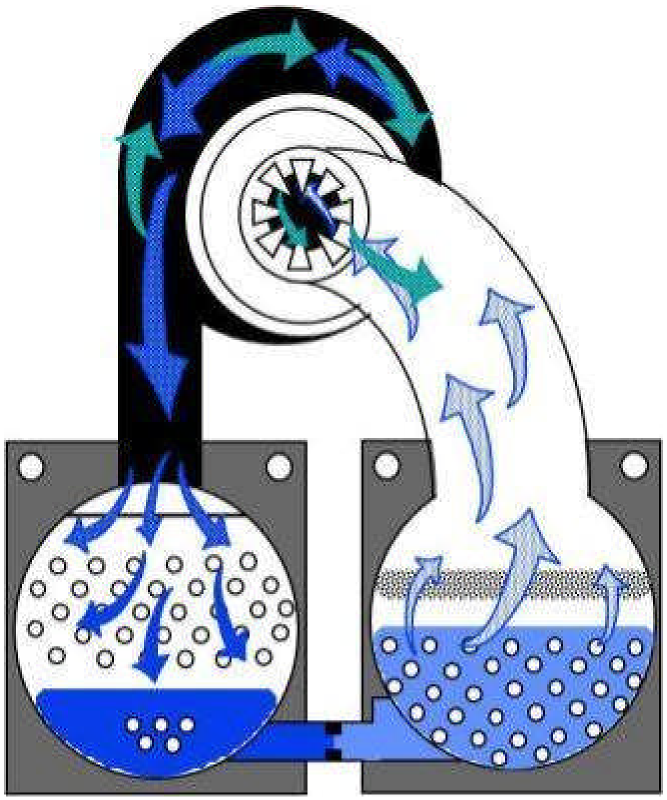

Maintenance

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Routine Inspection

- ✓ Check in with the customer and discuss any operational issues or problems
- ✓ Perform a visual check of the unit and listen for any unusual noises
- ✓ Record operating conditions
- ✓ Review the equipment logs made by the operators
- ✓ Perform visual inspection of auxiliary equipment, such as water pumps and tower

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Maintaining chiller performance

The greatest energy savings can be achieved with a system that operates as it was originally designed.

This requires a maintenance program that keeps the components operating at the original specifications.

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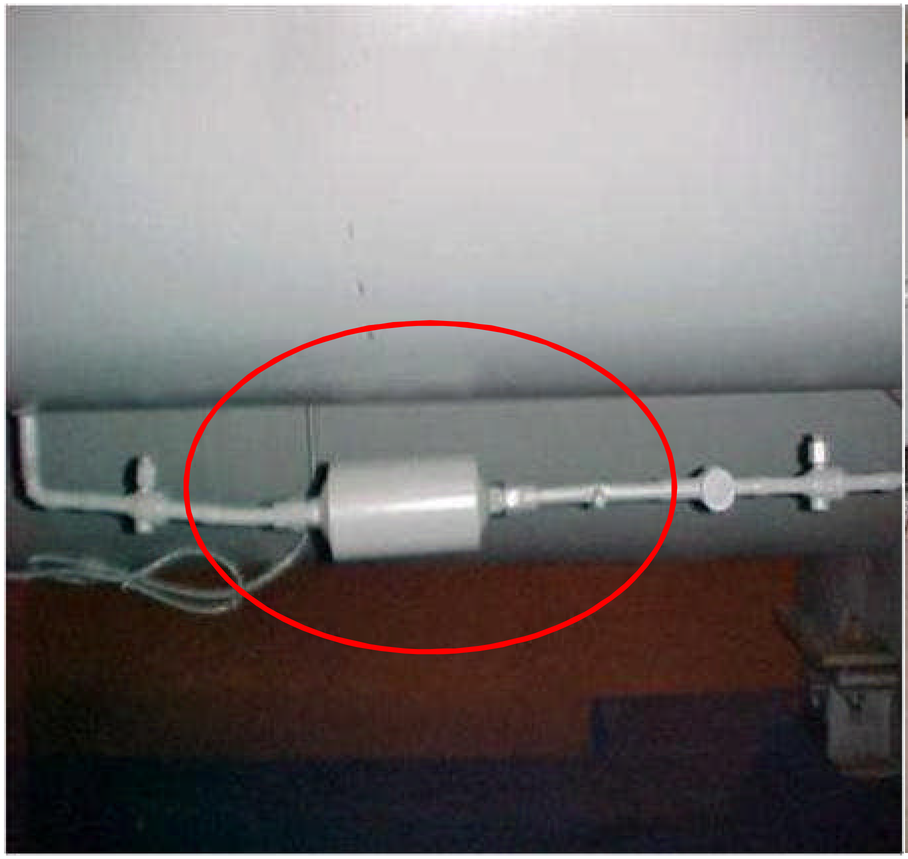
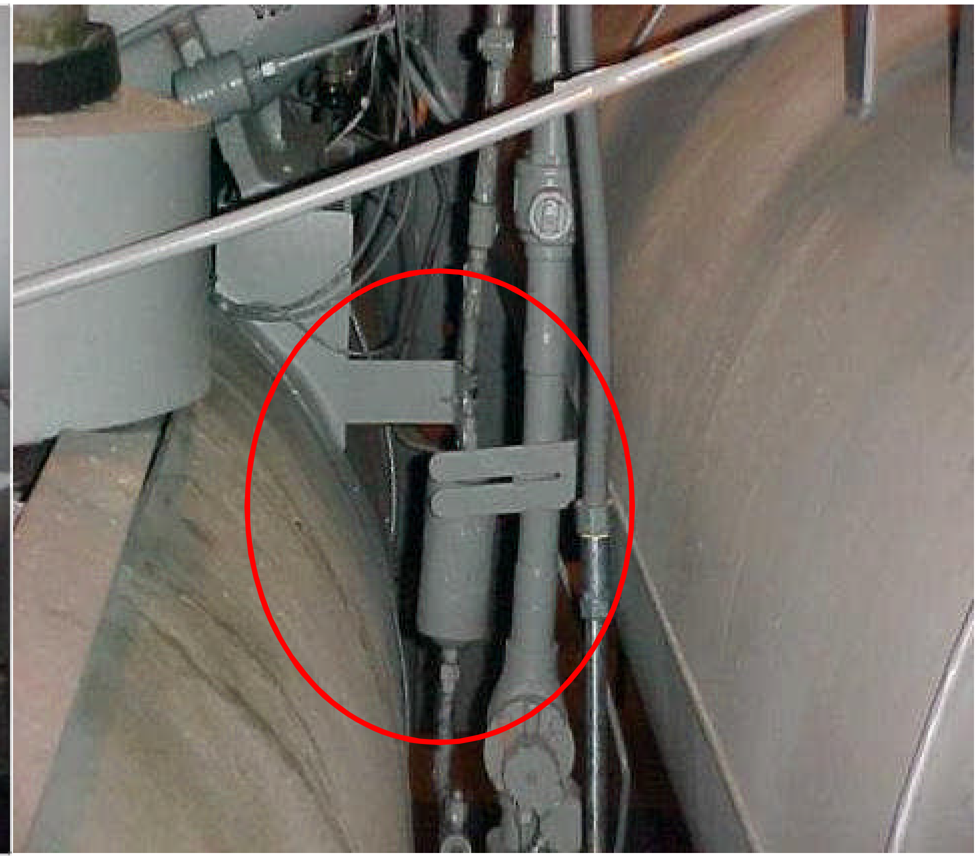
Maintenance Summary
Min Requirement for Annual Maintenance

1. Replace the refrigerant filters
2. Replace the oil filters
3. Replace the refrigerant strainers when the refrigerant is transferred
4. Calibrate the transducers and check the sensors annually
5. Remove oil sample for analysis before annual service
6. Leak Test the unit for refrigerant leaks
7. Tighten all electrical connections and inspect the components
8. Inspect the tubes and clean as necessary
9. Measure Water Pressure Differentials and compare to design
10. Review operating logs, alarm history, and discuss equipment operation with the operator

Carrier
Turn to the Experts.

1. Replace refrigerant filters





2. Replace oil filter cartridge

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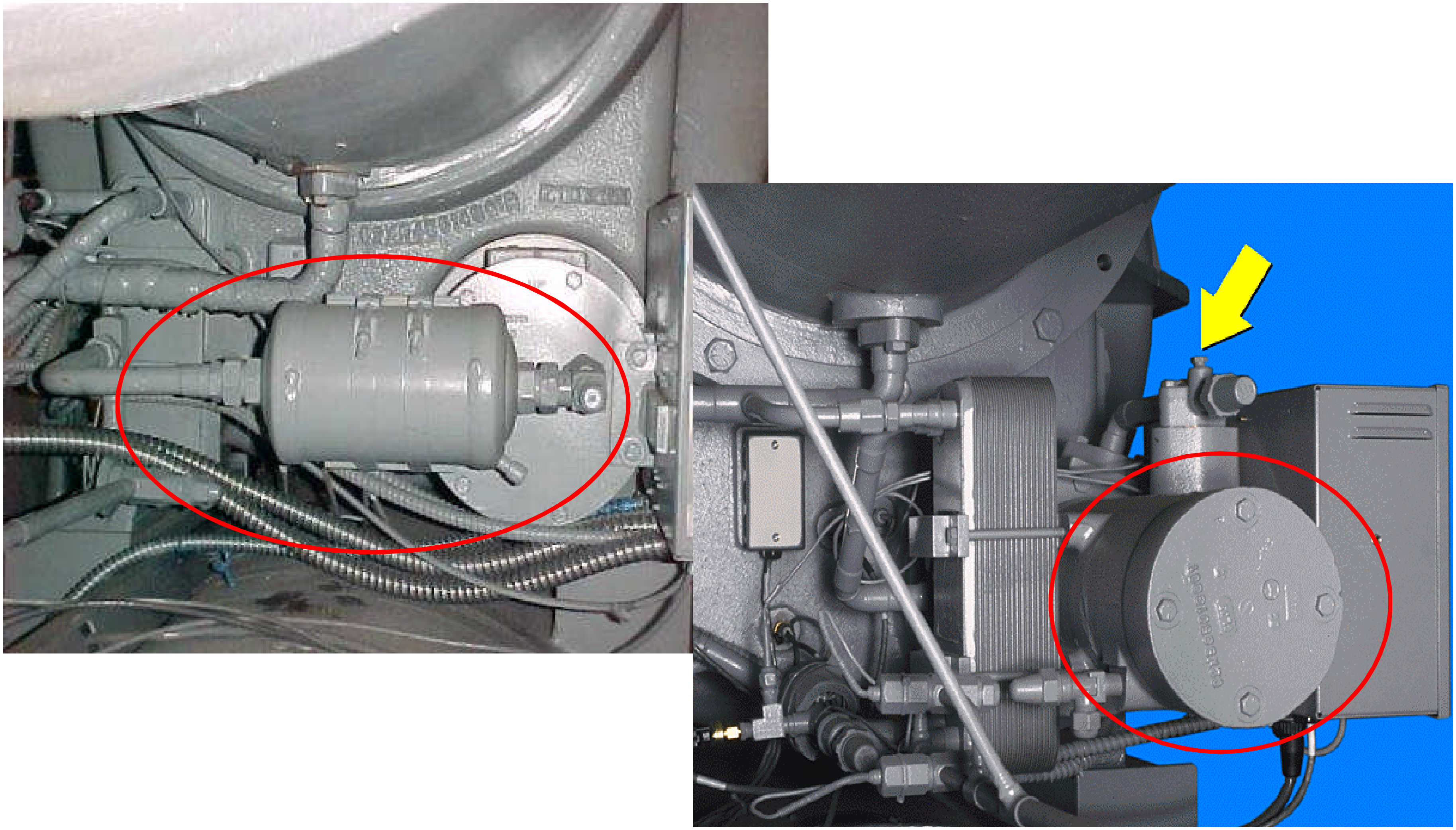

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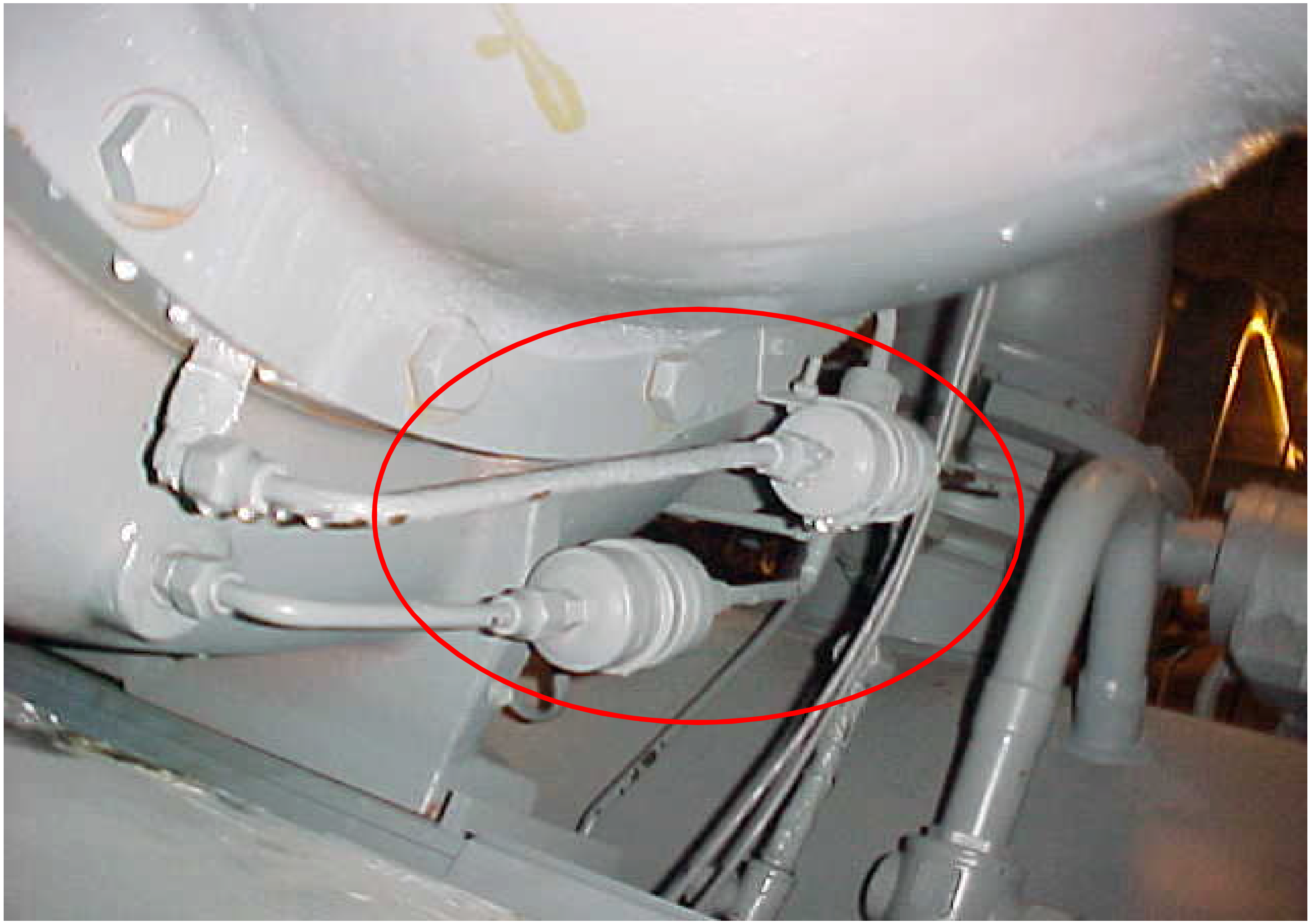
Turn to the Experts.

3. Replace the refrigerant strainers when the refrigerant is transferred

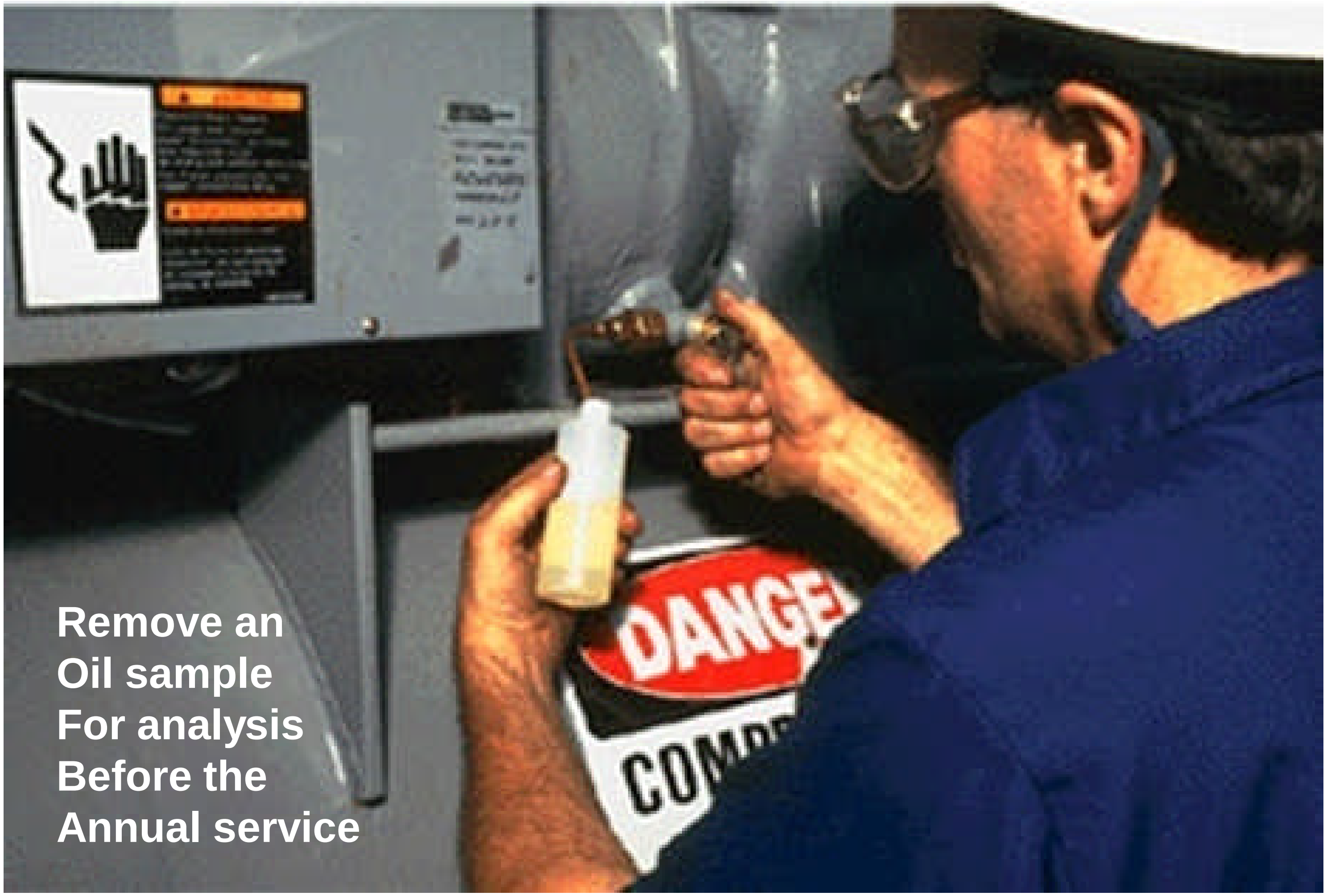


Carrier
Turn to the Experts.

4. Calibrate the transducers and check the sensors annually

Turn to the Experts.

5. Remove oil sample for analysis before annual service



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Oil Analysis

Turn to the Experts.

Test	Causes
Lubricant Type	• Check to confirm appropriate lubricate type is in the system
Moisture	• Weakens strength of lubricating film
	• Contributes to degradation of refrigerant
	• Contributes to creation of acid
	• Increases corrosiveness of acids
Acid Number	• Slow increase in over time is normal
	• Large change indicates either breakdown of refrigerant or severe oxidation of oil
	• High acid # will contribute to corrosion in the system
Wear Metals	• Iron, copper, chromium, tin, nickel, aluminum, lead
	o Gradual increase over time is acceptable
	o Sudden increase indicates abnormal wear
	• Zinc/Phosphorus are anti wear additives that will decrease gradually over time

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Oil Analysis (continue)

Test Parameters	Causes
Chloride/Floride	• High Levels results from breakdown of refrigerant • Good indicator of refrigerant health
Ion Activity	• High ion activity is caused by any one or combination of the high levels of wear metals, high acid #, high chloride/floride, high moisture • Gradual increase over time
Viscosity	• Dissolved refrigerant, oxidation of lubricant, excessive contamination changes viscosity • Not a common problem in HVAC
Mixed Oil Percentage	• Identify contamination from other lubricants • Verify completion of a conversion from mineral to synthetic oil

19XRV

Sample Oil Analysis Report

Carrier Job No. :	059A11043	**Report Number :**	RR078280-001
Job Name :	La Tour	**Date Sampled :**	8/30/2012
CCS Office :	CCS Dallas/DFW Ctrls(59/50)	**Sampled By :**	B Boone
Manufacturer :	Carrier	**Contact Person :**	Chris Higgins
Unit Model :	19XR4647353KDH64	**Date Received :**	9/5/2012
Serial Number :	0407Q73656	**Date Analyzed :**	9/6/2012
Equipment ID :	0407Q73656	**Reported By :**	Gintare Scott
Machine Hours :	24614		

				Previous Samples		
	Units	Limits	Current Sample	11/8/2010	2/9/2009	2/7/2008
Water	ppm	< 300	126	33	43	11
Acid Number	mg KOH/g	< 0.5	0.076	0.027	0.058	0.034
Chloride	ppm	< 20	<3	<3	<3	<3
Fluoride	ppm	< 20	<3	<3	<3	<3
Ion Activity	mmhos	< 200	27	38	43	23
Aluminum	ppm	< 15	<1	<1	<1	<1
Copper	ppm	< 400	<1	<1	<1	<1
Chromium	ppm	< 15	<1	1	<1	<1
Iron	ppm	< 25	<1	1	<1	<1
Nickel	ppm	< 15	1	2	<1	<1
Lead	ppm	< 15	<1	<1	<1	<1
Tin	ppm	< 15	1	3	1	<1
Zinc	ppm		3	4	4	<1
Phosphorus	ppm		<1	13	3	<1
Oil Type			POE	POE	POE	POE

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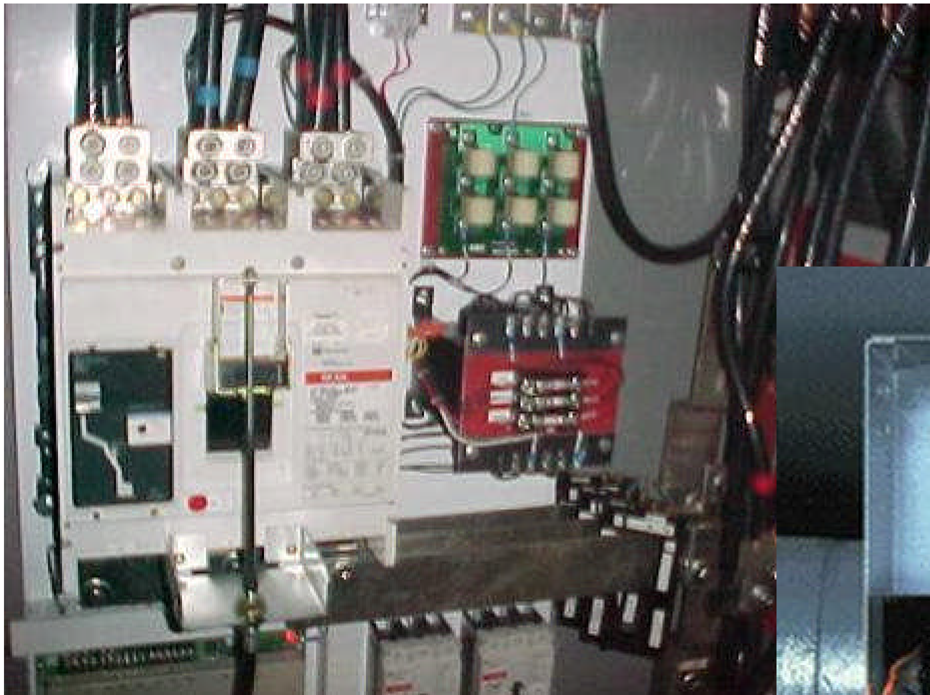
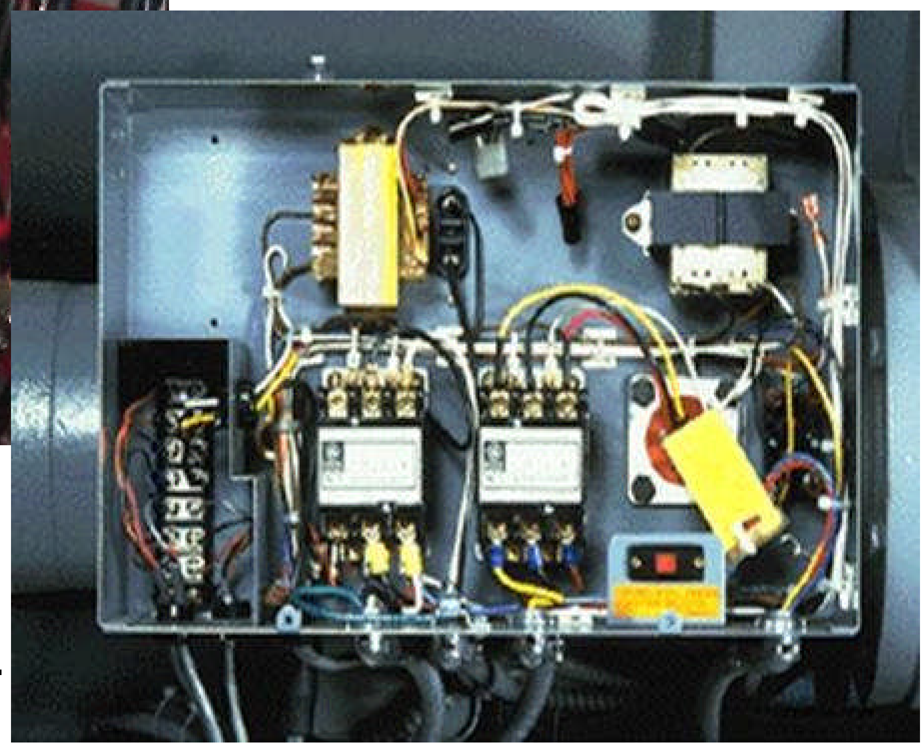
6. Leak Test the unit for refrigerant leaks

Turn to the Experts.

7. Tighten all electrical connections and inspect the components

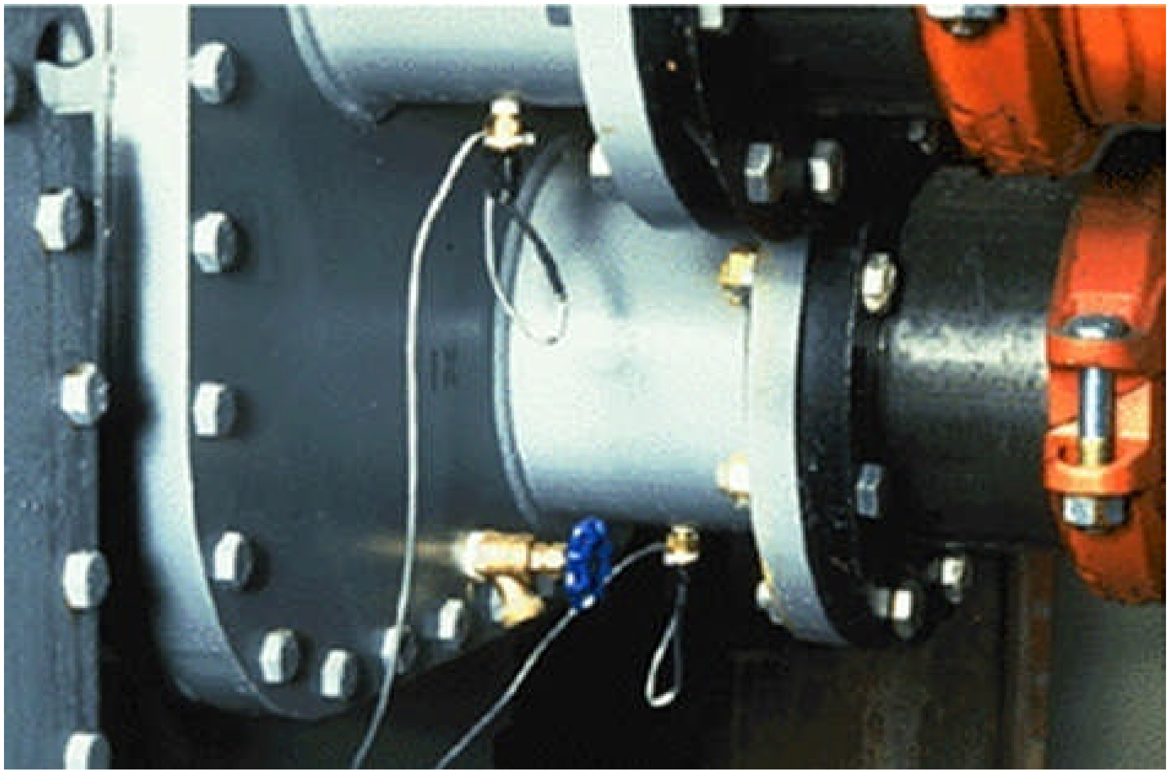


Clean enclosure and components
Of dirt and debris



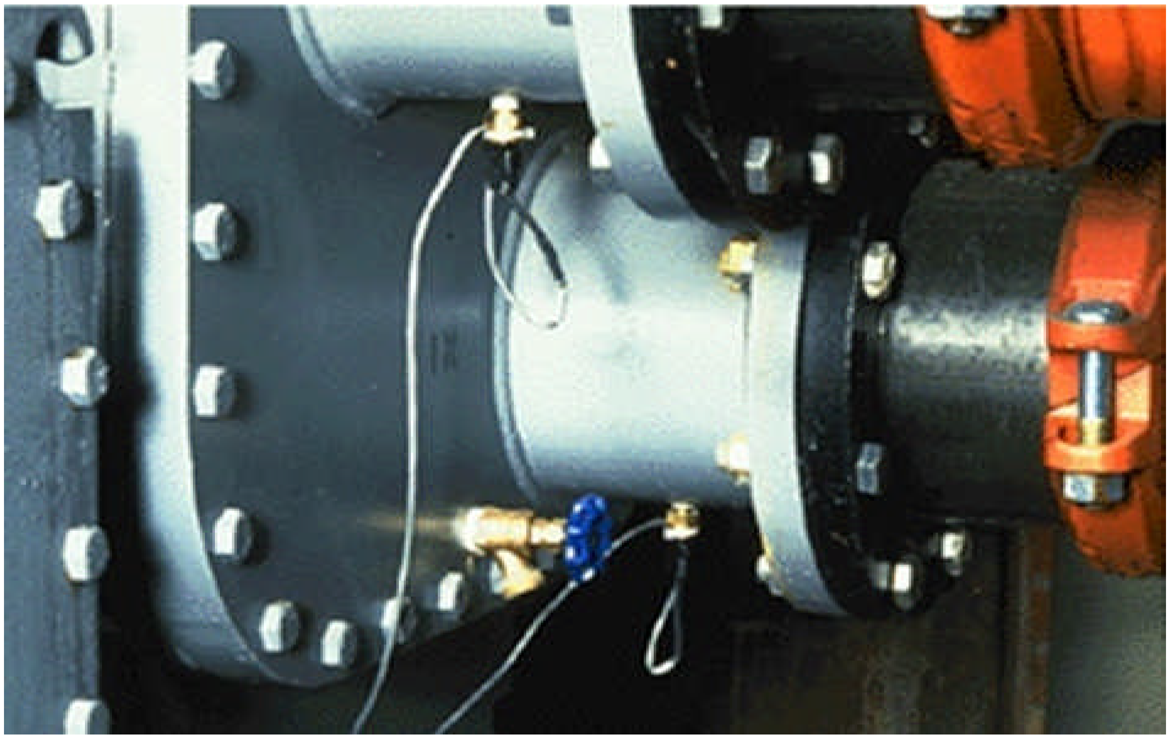
Check the condition of
And
Tighten the Electrical Connections
In the Starter and Control Panels

8. Remove the Water Box Covers and Inspect Tubes Cleaning as Necessary



Water Circuits exposed To the atmosphere should Be inspected annually. Closed circuit water loops Can be inspected at Longer intervals.

9. Measure Water Pressure Differentials and compare to design



If not at design:

1. Check Strainers
2. Valve position
3. Piping changes

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Carrier
Turn to the Experts.

10. Review operating logs, alarm history, and discuss equipment operation with the operator

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Refrigeration Log Form

Turn to the Experts.™

REFRIGERATION LOG ON CARRIER HERMETIC CENTRIFUGAL REFRIGERATION MACHINE

Plant/Bldg. ______________ MACHINE MODEL NO. ______________________ MACHINE SERIAL NO. __________________ REFRIGERANT TYPE ________________

	COOLER							CONDENSER							COMPRESSOR						
	Refrigerant		Water					Refrigerant		Water						Oil			Motor		
			Pressure			Temp.				Pressure			Temp.						FLA ____		
Date/Time	Press.	Temp.	In	Out	GPM	In	Out	Press.	Temp.	In	Out	GPM	In	Out	Bearing Temp	Press.Diff	Temp. (reservoir)	Level	Amperage (or vane position)	Operator Initials	Remarks

REMARKS: Indicate shutdowns on safety controls, repairs made, oil or refrigerant added or removed, air exhausted and water drained from dehydrator. Include amounts.

Other suggested task: Starter Check

Wye Delta Design- check the contactors, tighten electrical connections, inspect the transition resistors, and check the motor resistance with a meg-ohm meter.

Solid State- check the resistance of the SCR’s that is provided by the manufacturer, inspect the bypass contactors, tighten electrical connections, and check the motor resistance with a meg-ohm meter with the motor leads disconnected from the starter.

Variable Speed Drives- check the resistance of the rectifier/filter/inverter with comparison to the manufacturer limits, replace cooling fans as required, verify the accuracy of the current/voltage/frequency displays, and check the motor resistance with a meg-ohm meter with the motor leads disconnected from the starter

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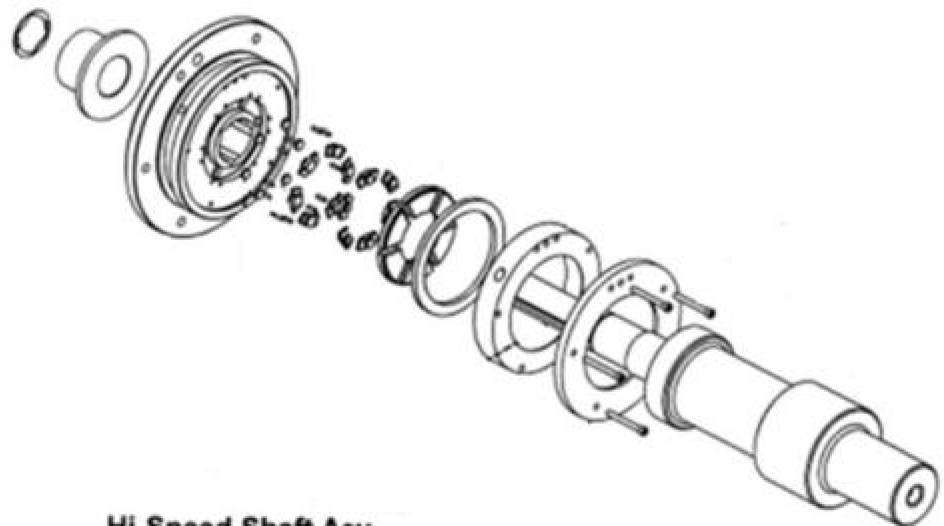
Other suggested task: Vibration Analysis

Turn to the Experts.

A compressor with rolling element bearing design will require vibration trending to determine bearing wear.

Oil analysis will provide the condition of the oil, but will not indicate bearing wear as it would with a babbitt surfaced bearing with an increased tin level.



Hi-Speed Shaft Asy

Compressors Without Roller Element Bearings

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Good Service Practice

Turn to the Experts.

✓Always evacuate any area opened for service to prevent non-condensables from entering the system

✓Leak test the area after completion of the work

✓Turn in oil sample as quickly as possible to prevent potential contamination

✓Clean up your work area and complete all paperwork

19XRV SERVICE UPDATES

Chiller Efficiencies Maintenance

19XRV SERVICE UPDATES

Chiller efficiency

Carrier®
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The following factors can reduce chiller efficiencies

1. Air/Non-condensables
2. Scaled or Dirty Condenser Tubes
3. Low Condenser water flow
4. Refrigerant (contaminated, too much, too low)
5. Excessive chilled water flow
6. Dirty chilled water tubes

19XRV SERVICE UPDATES

Air in the machine

ΔP across condenser is at design, and ΔT across condenser fairly close to design

Approach is above design

Gauge pressure(converted to temperature) and condensing liquid temperature is greater than 1-2°F

This means that there is non-condensables in the machine

Recommendations

Remove Air

19XRV SERVICE UPDATES

Fouled condenser tubes

ΔP across condenser is near design, and ΔT across condenser is less than design

Approach is above design

There is no non condensables in the heat exchanger as gauge pressure (converted to temperature) and condensing liquid temperature is within 1-2°F

Heat transfer surface area is reduced, condensing temperature increase which increase the lift

Recommendations

- Clean tubes
- Ensure water treatment is corrected

19XRV SERVICE UPDATES

Low condenser water flow

Turn to the Experts.

ΔP across condenser is less than design, and ΔT across condenser greater than design

Approach is slightly above design

Gauge pressure(converted to temperature) and condensing liquid temperature is within 1-2°F

Latent heat cannot be removed if flow is low

The condensing temperature will increase which will increase lift

19XRV SERVICE UPDATES

Low condenser water flow (continue)

Causes

- Plugged strainers at pump or tower
- Closed valves
- Pumps are performing/sized improperly
- Air in condenser water system
- Plugged tubes

Recommendations

- Clean strainers
- Open valves
- Correct Pumping station
- Bleed air from condenser water circuit
- Clean tubes

19XRV SERVICE UPDATES

Low Chilled water flow

ΔP across condenser is less than design, and ΔT across condenser greater than design

Approach is above design

Causes

- Plugged strainers
- Closed valves
- Pumps not performing/sized properly
- Plugged Tubes
- Air in Water

19XRV SERVICE UPDATES

Low Chilled water flow (continue)

Recommendations

- Clean strainers
- Open valves to correct ΔP
- Correct pumping stations
- Clean tubes
- Bleed air from chilled water system

19XRV SERVICE UPDATES

Refrigerant charge

Turn to the Experts.

- Low refrigerant charge
  - Compressor will compensate by lowering cooler pressure
  - Cooler refrigerant temperature will drop
  - Lift the compressor has to make will increase
- High refrigerant charge/contaminated refrigerant
  - Cooler pressure will lower
  - Risk of flooding the compressor

19XRV SERVICE UPDATES

Low Refrigerant charge at cooler

ΔP across condenser is at design, and ΔT across condenser is less than design

Approach is above design

Low motor amps at full capacity

Causes

- Leak/lost of charge
- Float valve not working
- Refrigerant stacking in condenser
- Too much oil

Recommendations

- Repair leaks
- Add refrigerant
- Check float valve

19XRV SERVICE UPDATES

Condenser water bypassing condenser tubes

Turn to the Experts.

ΔP across condenser is less than design, and ΔT across condenser is less than design

Approach is above design

Causes

- Division plate gasket ruptured
- Broken division plate

Recommendations

- Reinstall division plate gasket
- Repair/replace broken division plate

19XRV SERVICE UPDATES

Chilled water bypassing chilled water tubes

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